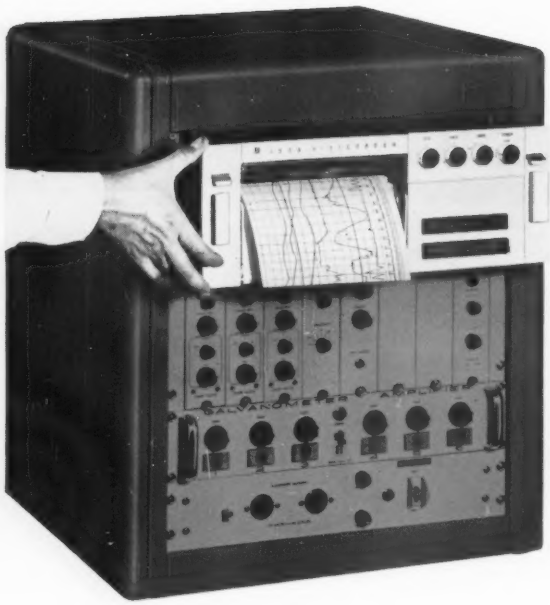
Aviation Week and Space Technology

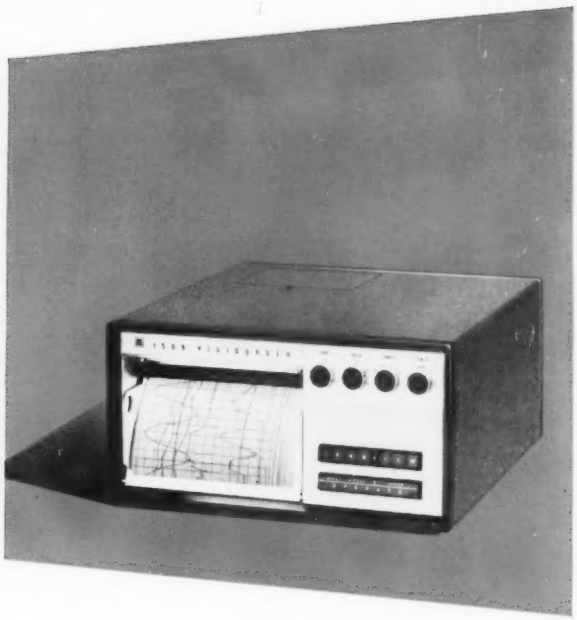
November 13, 1961

SPECIAL REPORT:

Swiss Air Force Close-Support, Intercept Roles

Hiller Ten99 Helicopter





In your case, or in ours

The new 1508 Visicorder should be your next oscillograph

The Model 1508 Honeywell Visicorder has been specifically designed to quickly and easily slide into your data reduction system. There it will serve as a direct information read-out device, recording DC to 5000 cps on from one to 24 channels; or it may serve as a monitor on other components in your system; or it may do both jobs, simultaneously if you wish.

You have no "data reduction system," as such? Then consider the trim, convenient 1508 as a bench instrument. Its push-button controls, selection of 12 chart speeds (metric, if desired), 8″ paper width, and direct writing speeds exceeding 50,000 in./sec. will help to make it one of your most useful tools. Its rigid, cast base assures constant alignment of optical components regardless of external stress on the instrument.

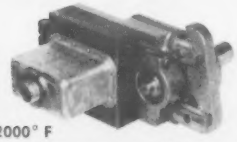
In your case . . . the 1508 needs only 7″ of rack height. In ours . . . it arrives ready to go to work as a convenient, portable instrument. In *any* case, be sure to see the new 1508 Visicorder before you order your next oscillograph. Write for Catalog HC-1508 to Minneapolis-Honeywell, Heiland Division, 5200 East Evans, Denver 22, Colorado.

Honeywell

H First in Control

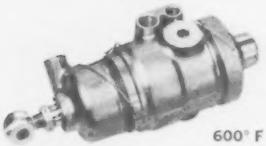
450° F

Mach 3 starter motor/pump



2000° F

Hot gas servo valve



600° F

Titanium rudder actuator

600° F

Hi-temp servo valve

400° F

Dual pump for X-15

CAPABILITY is spelled

M-a-c-h 3 s-y-s-t-e-m-s

Flight speeds of Mach 3 and higher introduce new problems in auxiliary power system design and operation. A well defined program* in existence for more than six years at Vickers has been devoted to high temperatures—in the 350° to 1400° F range—and their effects on materials, fluids and tolerances.

Exotic Fluids—Systems have been designed and tested for a broad range of hard-to-handle fluids including: deodorized kerosene at 350° F . . . synthetic base fluids (MLO 8200) at 450° F . . . super refined mineral oil (MLO 7243) at 700° F . . . mixed isomers of bis (phenoxyphenyl) ether at 700° F . . . liquid metal (NaK 77) at temperatures to 1400° F.

Hi-temp Components—Specialized high temperature applications require parallel activity in servo systems and related components (see examples at left). A typical development program includes servo valves for the −65° to 500° F range with extremely low thermal drift.

Compatible Materials—Related studies evaluate manufacturing and application problems on materials including tungsten and titanium carbides, titanium and high alloy stainless steels. All have optimum application in providing extra strength needed at minimum additional weight on actuators, valves, pumps and subsystems packages.

Specific facts about Vickers accumulated experience, facilities and "hardware" delivered are available. Ask for Bulletin A-6004.

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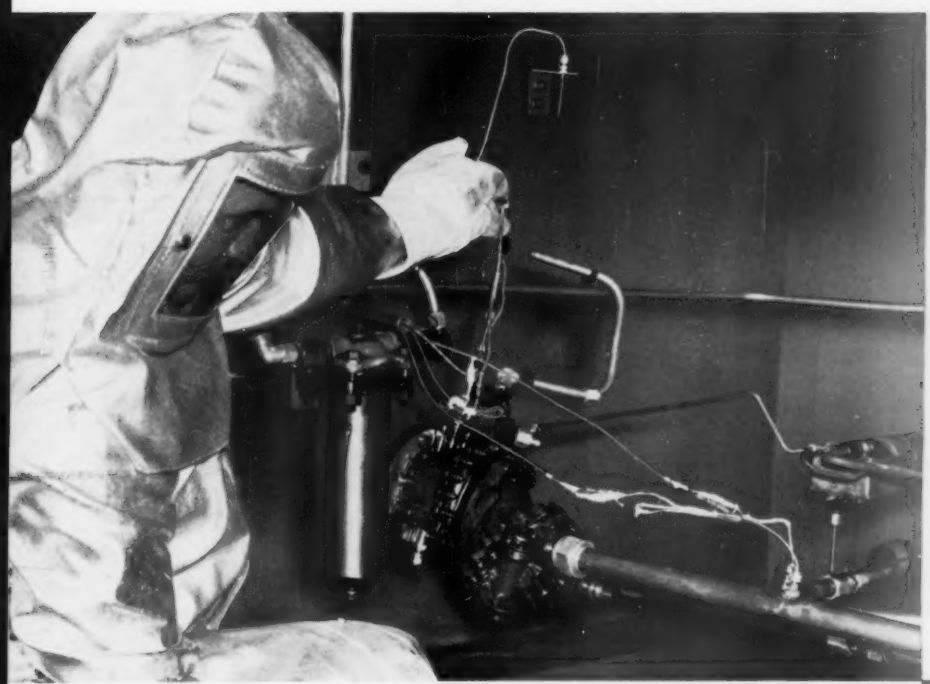


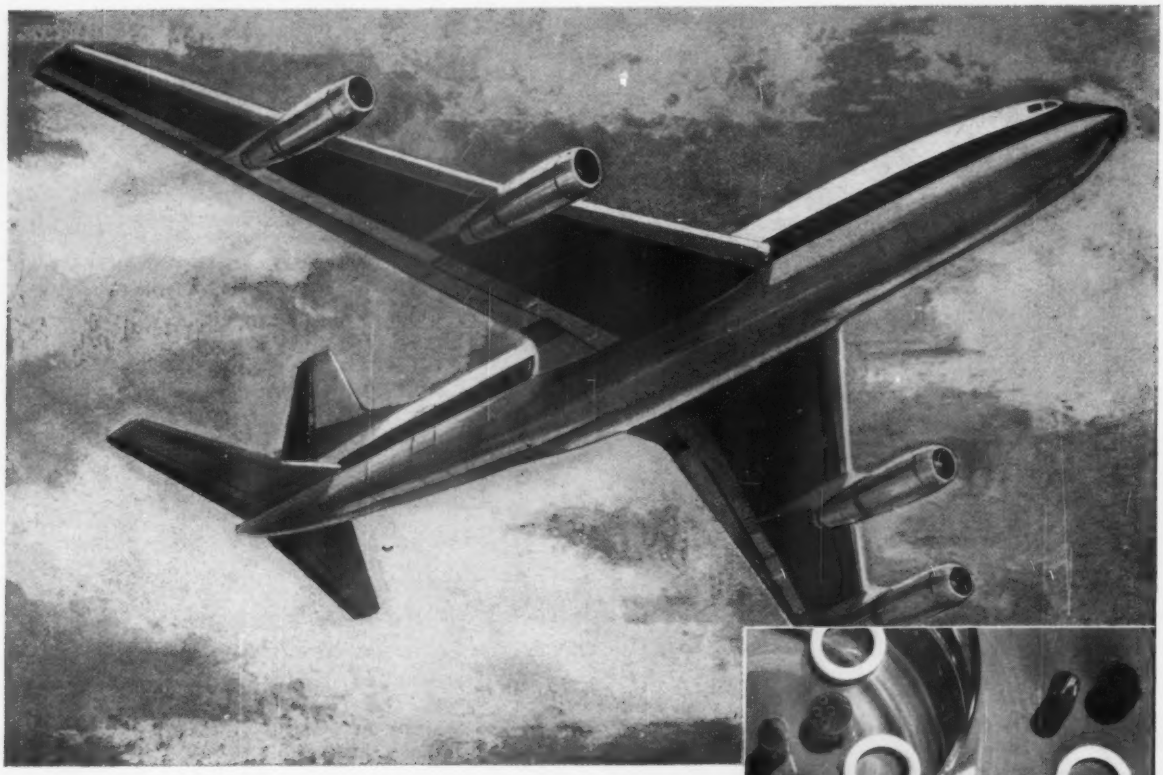
At completion of high temperature test, technician removes prototype pump that is heart of system being developed for Mach 3 flight. Systems are often hermetically sealed and pressurized with inert gas, necessitating special test facilities to simulate operating conditions.

Hot hardness tester is used to predict behavior of special alloys during extended operations at elevated temperatures.

Maximum safety building located at some distance from main research facilities has test cells used extensively in high temperature tests.

SILICONE NEWS from Dow Corning

Where reliability counts



Silastic LS parts at left show negligible swell after prolonged immersion in JP-4 fuel. Identical parts at right were not immersed.

Here's why Silastic® LS is specified to seal jet fuel in . . . trouble out

Seals that come into contact with jet fuel must always perform as if they are *brand new* . . . installed only moments before take off on today's intercontinental jetliners.

Chances are, however, these seals have been in use for months. Hundreds of hours of *over-the-weather* flying have exposed them to the attack of ozone. Minutes after take off these seals can plunge from oven-like runway conditions to high altitude temperatures of —60 F. Yet, despite repeated thermal cycling and exposure to rubber-killing conditions, these seals must maintain their integrity . . . exhibit no evidence of cracking or checking. They must remain flexible in the bitter cold at high altitude to assure completely reliable operation . . . and, though they are in constant contact with jet fuel, resist swell and tenderizing.

When you study the photograph and chart of properties at right, it's easy to see why Silastic LS, the fuel-resistant silicone rubber is specified as standard material for many jetliner seals.

PROPERTIES CHART

Physical Properties	
Hardness, (Shore A)	50-65
Tensile Strength, psi	800-1000
Elongation, percent	150-170
Brittle Point	—90

Fuel Resistance (JP-4)

	Durometer Change	*Tensile Str'gth Change %*	*Volume Change %*
After 30 days immersion	—5	—31	+10

Weather Resistance	
After 31 months (3549 sun hours) at Florida Test Station	no visible effects

For information about Silastic LS and a list of part suppliers, write Department 1423, Dow Corning Corporation, Midland, Mich.

first in silicones

Dow Corning

AEROSPACE CALENDAR

Nov. 19-22—Symposium on Biomedical Aspects of the Space Sciences, University of California at Los Angeles. Sponsors: Brain Research Institute, UCLA; Air Force Office of Scientific Research.

Nov. 19-24—Medical and Biological Problems in Space Flight Conference, Nassau, Bahamas.

Nov. 27-29—Vehicle Systems Optimization Symposium, Institute of the Aerospace Sciences, Garden City Hotel, Garden City, N. Y.

Nov. 27-Dec. 1—Army-Industry Aviation Logistics Symposium, Congress Hotel, St. Louis, Mo.

Nov. 28-30—38th Meeting, Aviation Distributors and Manufacturers Assn., Jung Hotel, New Orleans, La.

Nov. 30-Dec. 1—12th National Conference, Institute of Radio Engineers' Professional Group on Vehicular Communications, Radison Hotel, Minneapolis, Minn.

Dec. 4-5—Beryllium Metallurgy Conference, New York University's Washington Square Center, New York, N. Y.

Dec. 4-6—Specialists' Meeting on Aerospace Support and Operations (classified), Institute of the Aerospace Sciences, Orlando, Fla.

Dec. 5—11th Annual Meeting, National Air Taxi Conference, Statler-Hilton Hotel, Washington, D. C.

Dec. 5-7—Annual Convention, National Aviation Trades Assn., Statler Hilton Hotel, Washington, D. C.

Dec. 12-14—Eastern Joint Computer Con-

(*Continued on page 6*)

AVIATION WEEK and Space Technology

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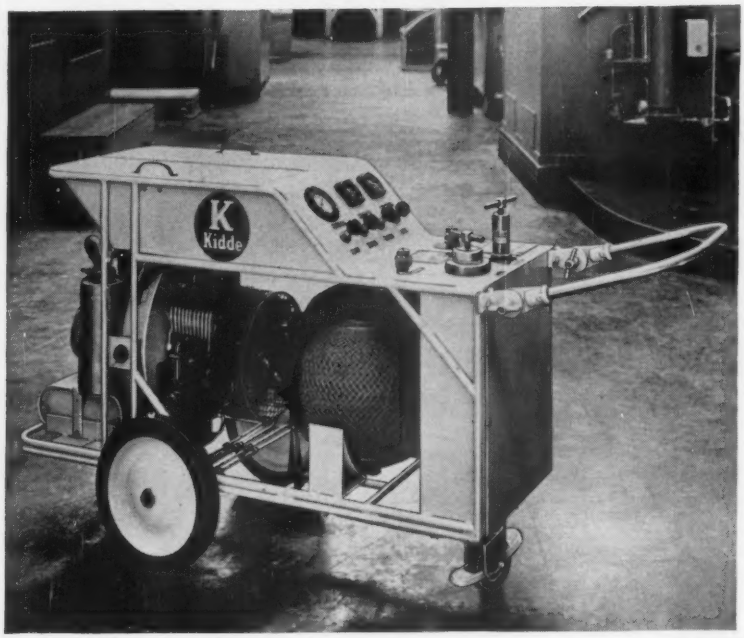
New Kidde 5000 psi pneumatic system features mobility, precision regulation!



From the laboratories of Walter Kidde & Company, Inc., comes this mobile pneumatic system which delivers 4 cfm of clean, dry air at pressures up to 5000 psi. Completely portable and easy to maneuver, the system features two highly accurate regulators: one for pressure ranges of 0-200 psi; the other for pressures up to 5000 psi. All controls and gauges have been placed at the optimum level for accessibility and ease of handling. Light in weight, the system measures 22″ by 49″ by 32″, and is available powered with either electric or hydraulic motors or gasoline engine.

Used for aircraft and missile ground-support equipment and for laboratory applications, systems of this type can supply high and low-pressure air in ambient temperatures varying from —40 degrees to +120 degrees F. For more information, write Kidde today.

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AEROSPACE CALENDAR

(*Continued from page 5*)

ference, Sheraton Park Hotel, Washington, D. C.

Dec. 18—25th Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C.

Jan. 8-12—1962 Automotive Engineering Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit.

Jan. 9-11—Eighth National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D. C.

Jan. 15-17—Symposium on Optical Character Recognition, Department of the Interior Auditorium, Washington, D. C. Sponsored by Information Systems Branch/Office of Naval Research and Research Information Center/National Bureau of Standards.

Jan. 21-24—Annual Meeting, Helicopter Assn. of America, Marriott Motor Hotel, Dallas, Tex.

Jan. 22-24—30th Annual Meeting, Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 23.

Jan. 23-26—Third Annual Solid Propellant Rocket Conference, American Rocket Society, Baylor University, Waco, Tex.

Jan. 24-26—Second Symposium on Thermophysical Properties, Princeton, N. J. Sponsor: Heat Transfer Division, American Society of Mechanical Engineers.

Feb. 6-7—Symposium on Redundancy Techniques for Computing Systems, Department of the Interior Auditorium, Washington, D. C. Sponsor: Information Systems Branch, Office of Naval Research.

Feb. 7-9—Third Winter Convention on Military Electronics, IRE, Ambassador Hotel, Los Angeles.

Feb. 14-16—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

Feb. 19-21—Range Reconnaissance and Tracking of Aerospace Vehicles, Institute of the Aerospace Sciences, San Francisco.

Feb. 27-Mar. 1—Third Annual Symposium on Nondestructive Testing of Aircraft and Missile Components (unclassified), Gunter Hotel, San Antonio, Tex. Sponsors: South Texas Section-Society for Nondestructive Testing; Southwest Research Institute.

Feb. 27-Mar. 1—Symposium on the Application of Switching Theory in Space Technology, Palo Alto, Calif. Sponsors: Lockheed Aircraft Corp.; Air Force Office of Scientific Research.

Mar. 1-3—Eighth Scintillation and Semiconductor Counter Symposium, IRE, Shoreham Hotel, Washington, D. C.

Mar. 5-8—Seventh Annual Gas Turbine Conference and Products Show, American Society of Mechanical Engineers, Shamrock Hilton Hotel, Houston, Tex.

Mar. 8-9—Institute of the Aerospace Sciences' Flight Propulsion Meeting (classified), Cleveland, Ohio.

Mar. 14-16—Electric Propulsion Conference, American Rocket Society, U. S. Naval Postgraduate School, Monterey, Calif.

Mar. 26-29—International Convention, IRE, Coliseum and Waldorf Astoria, New York.

INPUT FROM OUT THERE
Man's comprehension of the cosmos grows with his ability to assess and control the space environment. This is the task of *astrionics*—the discipline that integrates electronics, optics, mechanics, and the information sciences into unified systems.
Aerojet-General's Astrionics Division, manufacturer of the infrared subsystem of the MIDAS satellite, offers complete capability in research, development, and production of advanced astrionic systems for—
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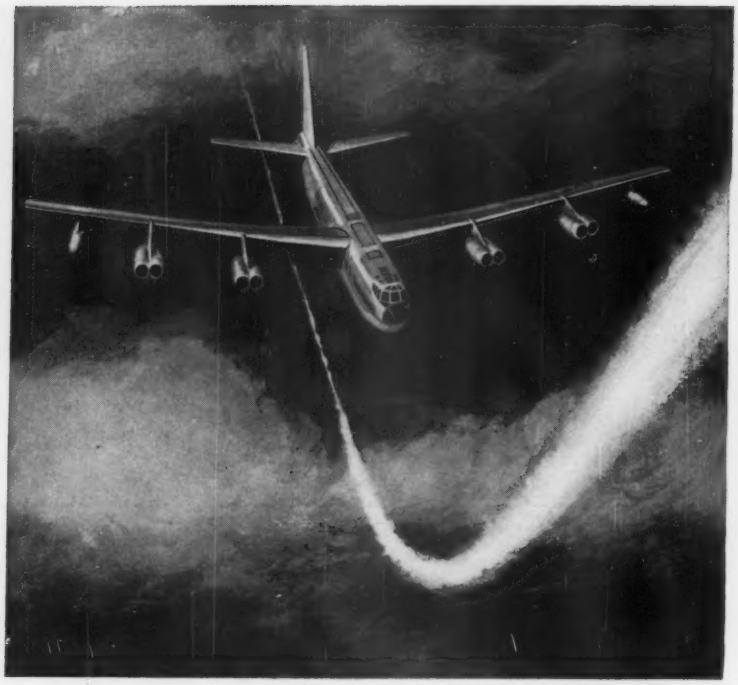

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Skybolt missile

***Engineers:** Kearfott offers challenging opportunities in advanced component and system development.*

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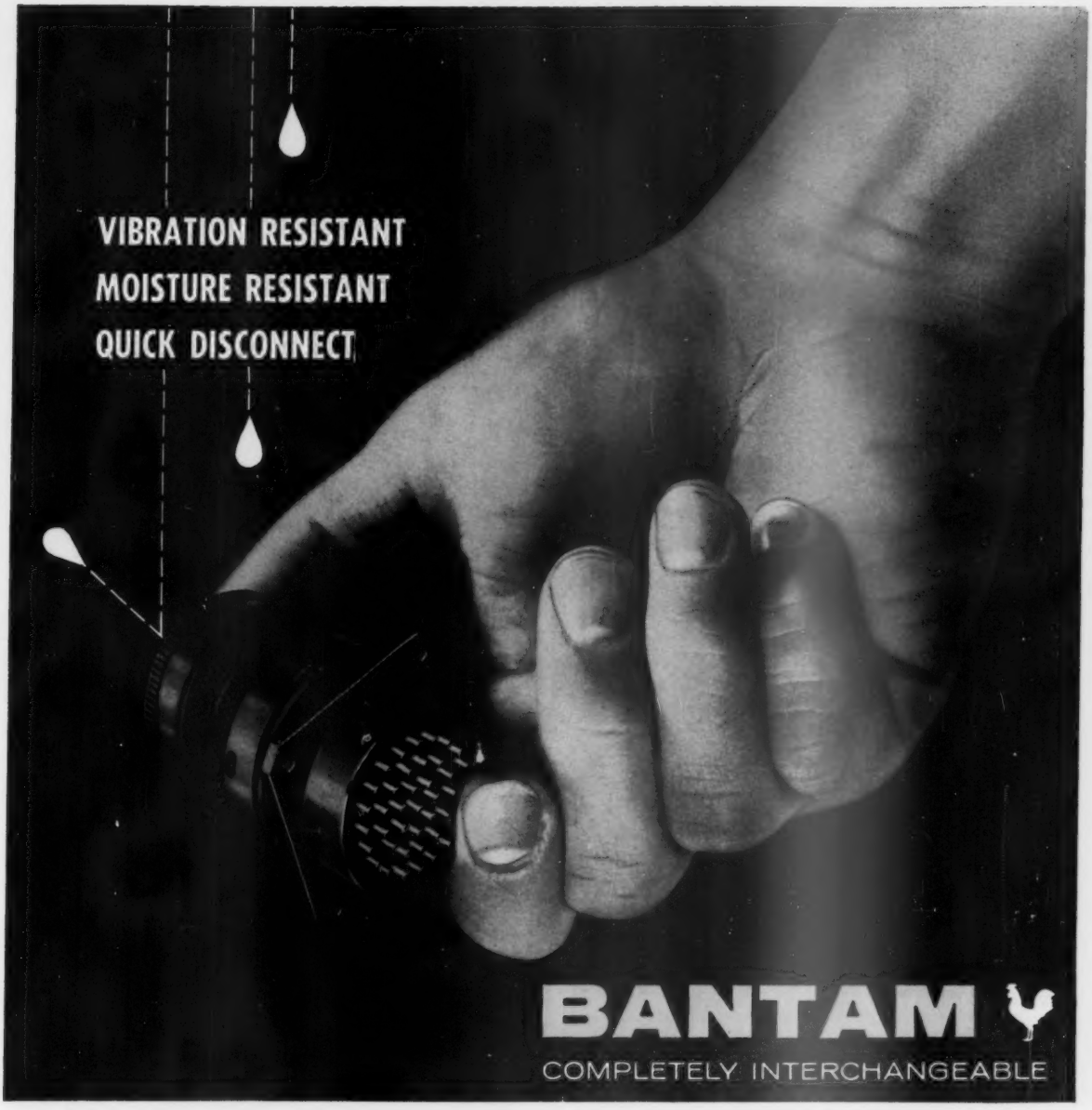

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Up to 32 contacts in an area the size of a ... providing for 61 contacts in an area slightly larger, the Bantam line is available in a wide variety of insert configurations and shell sizes. Extra heavy gold plating, 75 micro inches — far exceeding current specifications provides extra protection against corrosion. The Bantam contacts also provide hard gold mating against soft gold adding durability and minimizing galling. An exclusive wire-seal grommet will seal all required wires and in addition type EE Mil-W-16878. Electrically, mechanically, BANTAM connectors have proven completely dependable. Copper alloy closed entry sockets, extra heavily gold-plated over silver... moisture-proof resilient inserts ... cadmium-plated shells of impact-extruded aluminum... heavy spring tension for perfect interface sealing.

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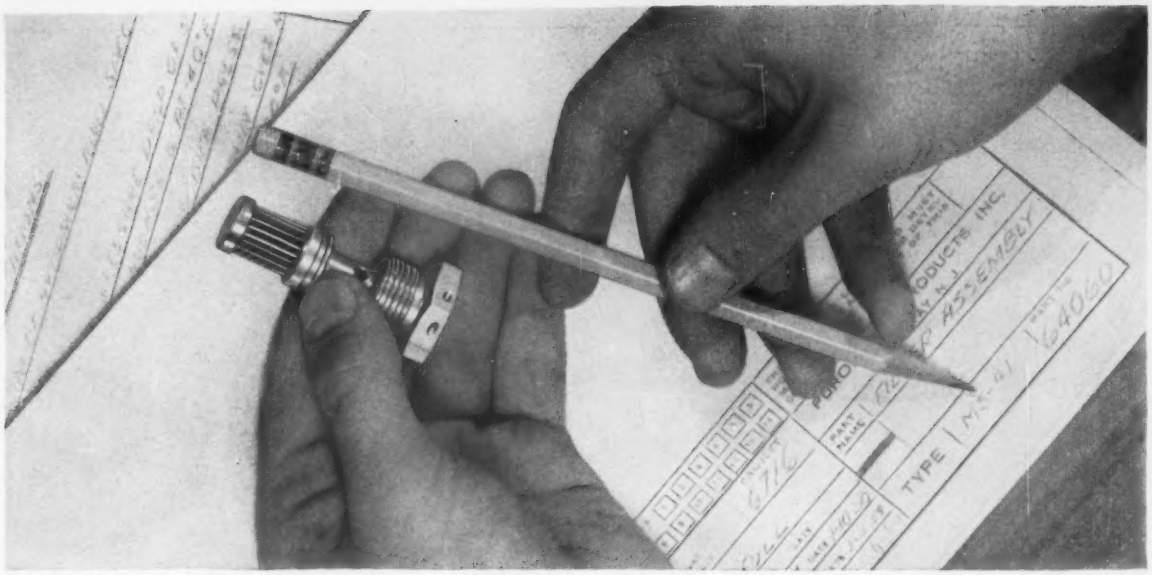

Miniaturized cavity-type filter packs 4.2 square inches of filtering area into 1" x 9/16" element

Purolator develops thumb-nail size element to protect hydraulic control circuits on Army's Hawk Missile mobile launcher.

How small can you make an element that must filter 2 gpm hydraulic oil at 2500 psi at any temperature within a 315° range? Purolator's new miniature cavity-type hydraulic filter is the best answer to date. Here's why:

4.2 square inches of convoluted stainless steel wire cloth are packed into this miniature filter. This element, which weighs 0.25 ounces, filters two gallons per minute of hydraulic oil, at temperatures ranging from —40° to + 275° F. The element will withstand 2500 psi differential pressure without collapsing.

The element is made up of a total of ⅛-mile of stainless steel wire, woven into wire cloth and convoluted to extend filtration area. This element will remove 98% of all particles whose two smallest dimensions are larger than 10 microns, and 100% of all particles measuring 25 microns or more.

The picture at the top of the page shows you the complete filter assembly, ready for installation in the hydraulic control system. The overall length of the unit is 2½₂"; maximum overall diameter is 1". Total weight is slightly over 1 ounce. Designed as a cavity-type unit, the filter is installed simply by screwing it into the hydraulic system so the filter element intercepts oil flow. The element can be removed, cleaned and replaced without special tools.

The picture at right shows the mobile launching platform for the Hawk Missile. The compactness and mobility of the

launcher, and the probability that it would be subjected to severe jolting, made it necessary to specify as small a filter as possible, and one that could be integrated with the rest of the system for maximum simplicity and durability.

The Purolator engineers who developed this new miniature cavity-type filter are available now to design a filter to meet your specifications. Simply contact Purolator Products, Inc., Department 3096, Rahway, New Jersey.

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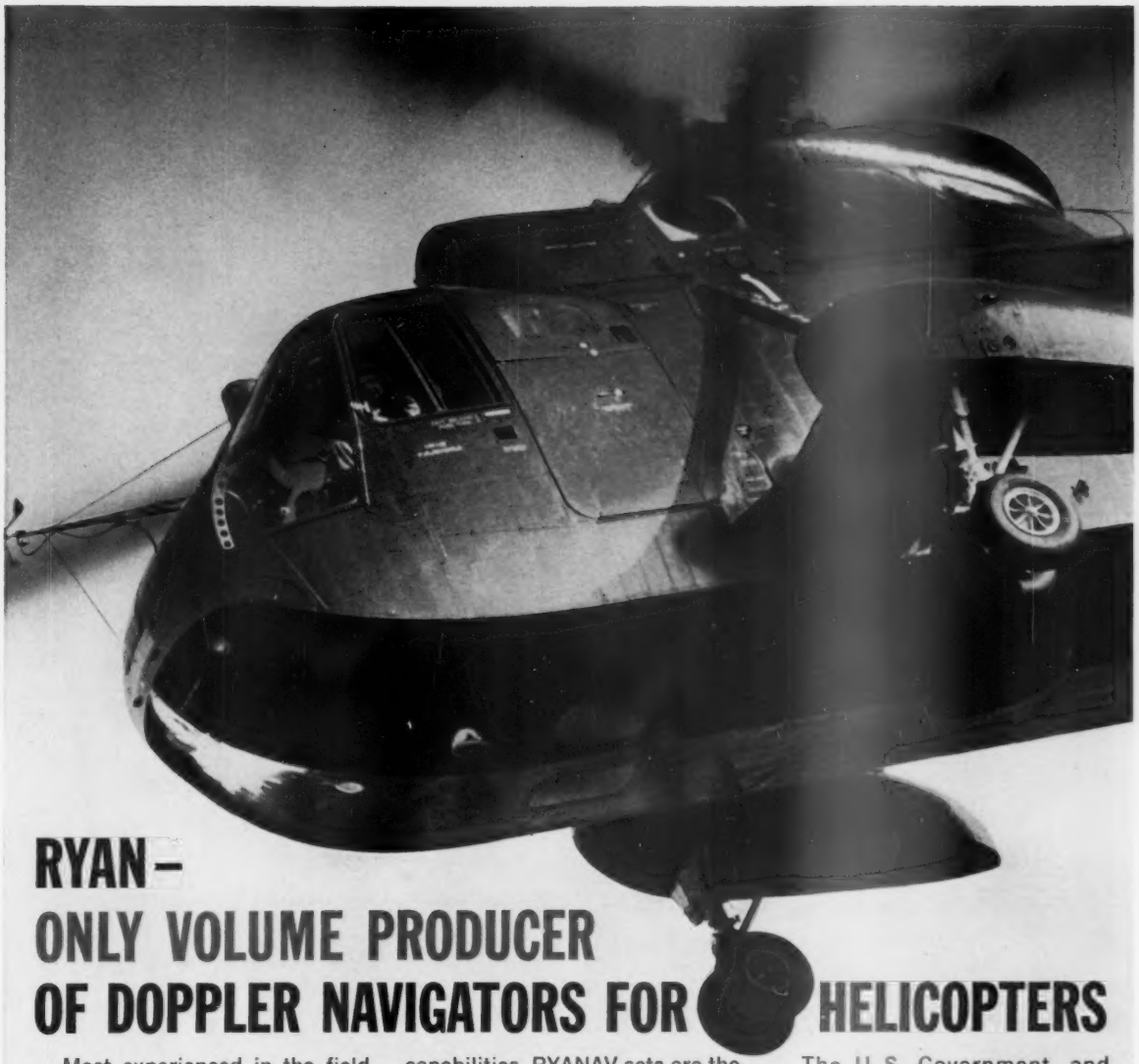

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Ryan Electronics offers challenging opportunities to engineers

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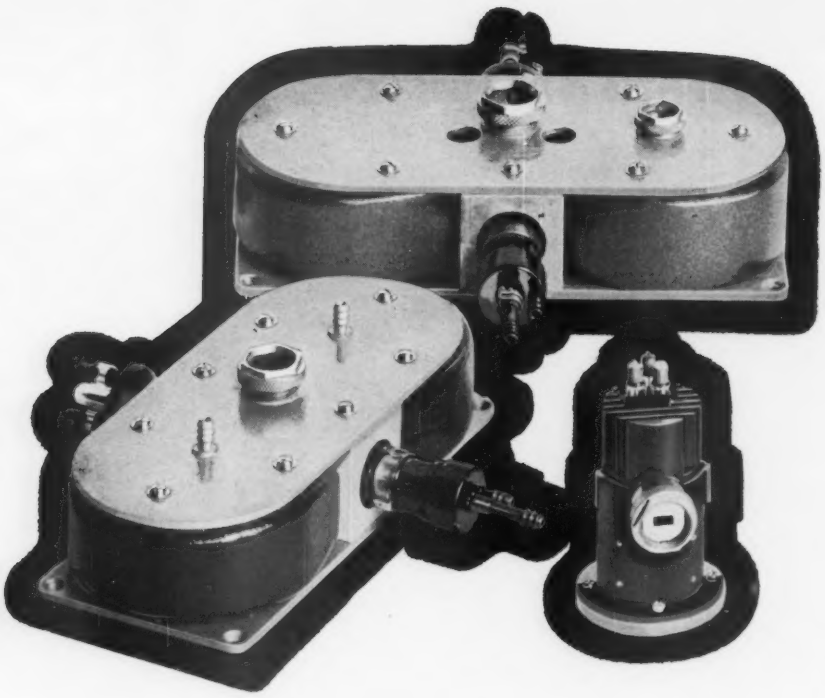

Ku-BAND TO 80 KMC

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L-3639	68 - 80	Fixed	0.500	Liquid
L-3689	68 - 80	1500	0.500 average	Liquid
L-3690	68 - 80	1500	0.100	Liquid
L-3691	68 - 80	1500	0.100 average	Liquid
L-3640	48 - 52	Fixed	1.0	Liquid
L-3693	48 - 52	1500	1.0	Liquid
L-3629	33 - 37	Fixed	15.0	Liquid
L-3628	33 - 37	1600	10.0	Liquid
L-3632*	33 - 37	1000	0.030	Air
L-3633*	33 - 37	1000	0.200	Air
L-3659	32 - 37	700	5.0	Liquid
L-3697	30 - 37	1600	1.5	Liquid
L-3698	30 - 37	1600	1.0	Air
L-3630	21 - 25	Fixed	10.0	Liquid
L-3631	21 - 25	1000	8.0	Liquid
L-3642*	18 - 25	400	0.100	Air
L-3692*	18 - 25	400	0.350	Air
L-3699	21 - 25	1000	1.5	Liquid
L-3700	21 - 25	1000	1.0	Air

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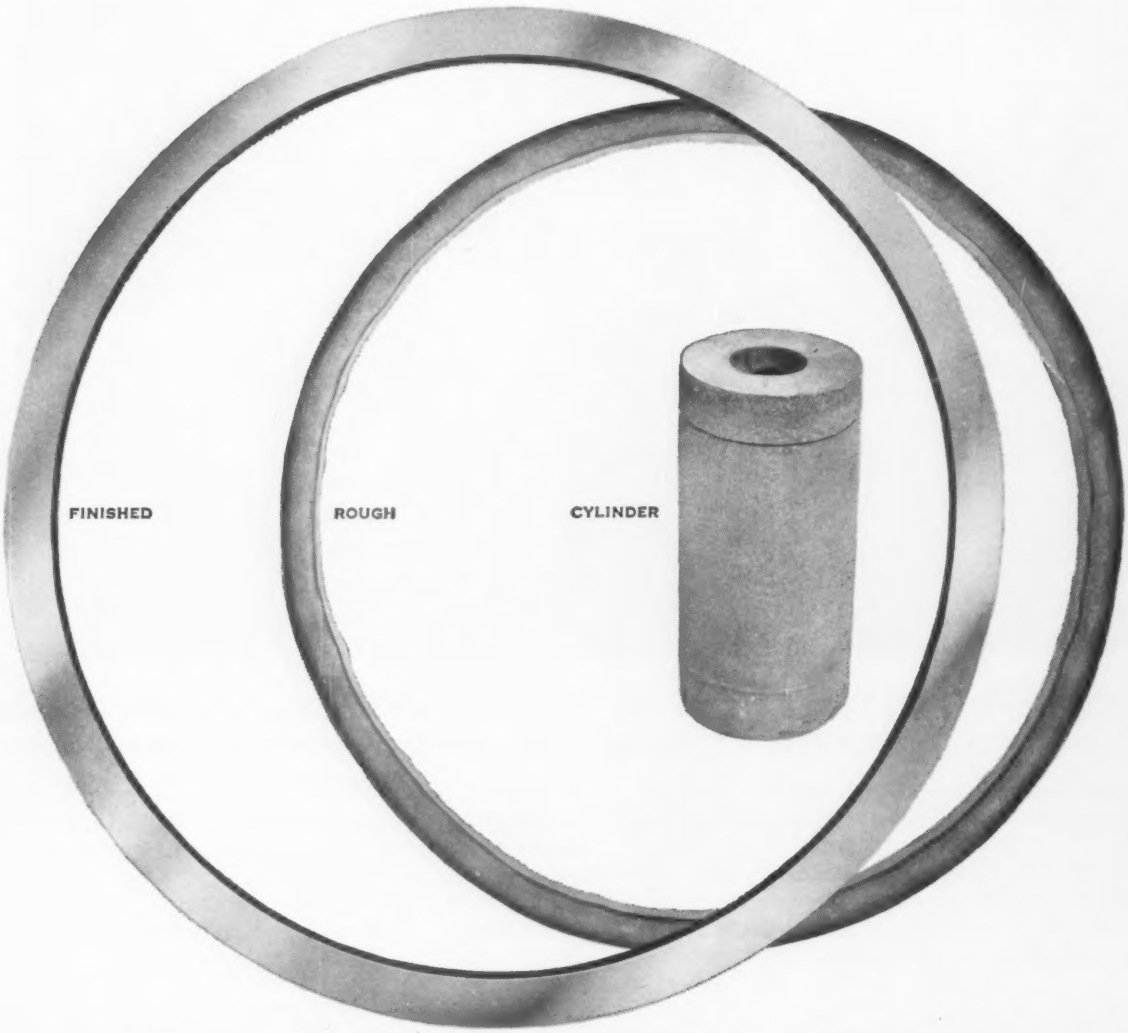

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Science Serves Defense at Westinghouse

The new underwater acoustic test laboratory pictured below will be in operation this year in Baltimore, helping Westinghouse engineers solve problems in oceanographic and ASW research.

Built by the Westinghouse Ordnance Department, the new laboratory is one of the largest and best-equipped privately-owned facilities of its kind. It is 205 feet long and 175 feet wide. The air-conditioned instrument house floats on a 3½ million gallon lake, 25 feet deep and with an anechoic lining.

The laboratory will advance the development of a wide range of Westinghouse underwater acoustic equipment. Included are transducers, detection systems, weapon homing and guidance systems, and high and low frequency sonar devices.

Underwater acoustic systems built by Westinghouse are a part of various Navy weapon systems. This new acoustic laboratory at Baltimore will bring continued contributions to this vital area of American strength.

Defense Products Group, 1000 Connecticut Avenue, N.W., Washington 6, D. C.
You can be sure . . . if it's Westinghouse.

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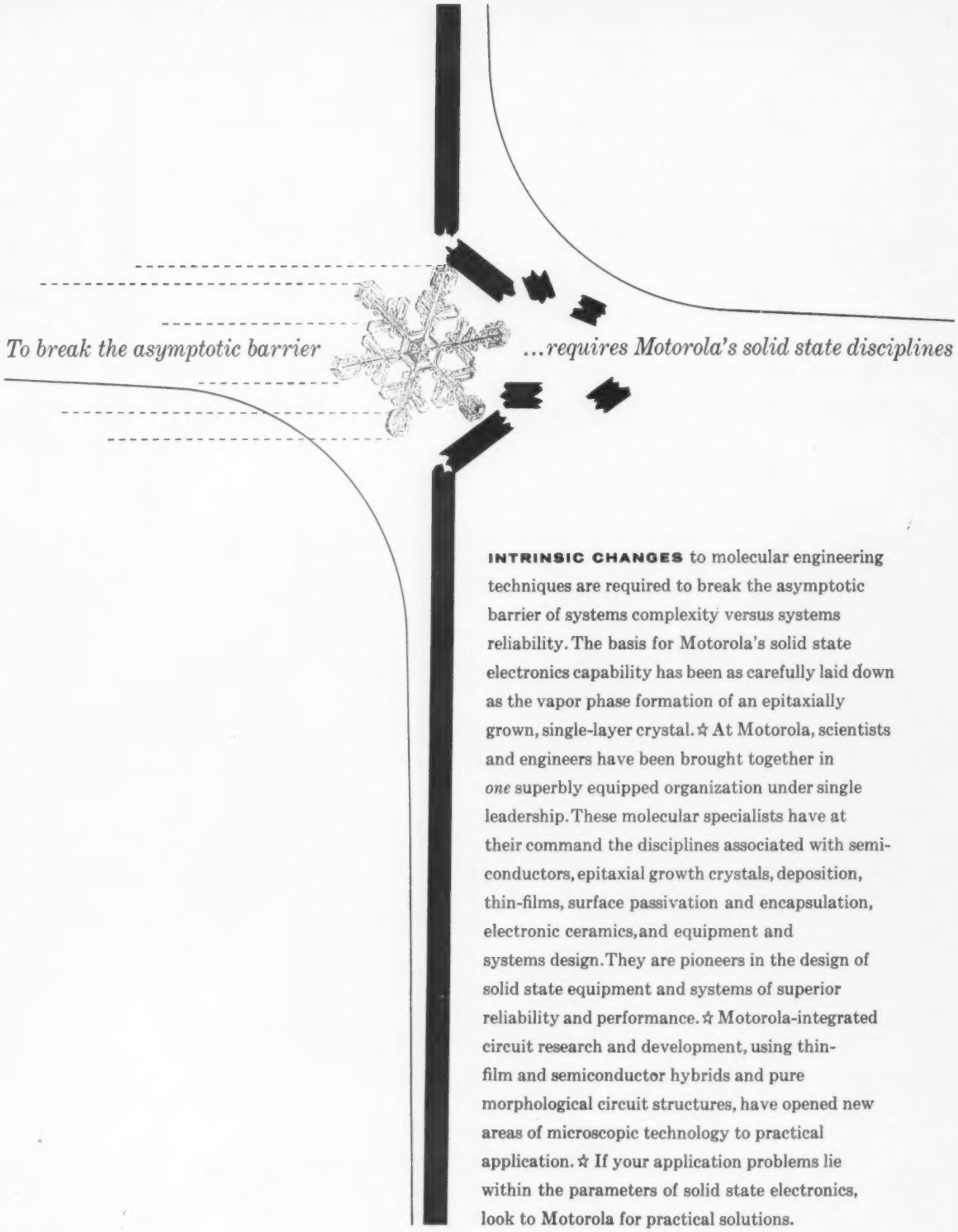
UNDERWATER ACOUSTIC LABORATORY...in our own backyard



INTRINSIC CHANGES to molecular engineering techniques are required to break the asymptotic barrier of systems complexity versus systems reliability. The basis for Motorola's solid state electronics capability has been as carefully laid down as the vapor phase formation of an epitaxially grown, single-layer crystal. ☆ At Motorola, scientists and engineers have been brought together in *one* superbly equipped organization under single leadership. These molecular specialists have at their command the disciplines associated with semiconductors, epitaxial growth crystals, deposition, thin-films, surface passivation and encapsulation, electronic ceramics, and equipment and systems design. They are pioneers in the design of solid state equipment and systems of superior reliability and performance. ☆ Motorola-integrated circuit research and development, using thin-film and semiconductor hybrids and pure morphological circuit structures, have opened new areas of microscopic technology to practical application. ☆ If your application problems lie within the parameters of solid state electronics, look to Motorola for practical solutions.

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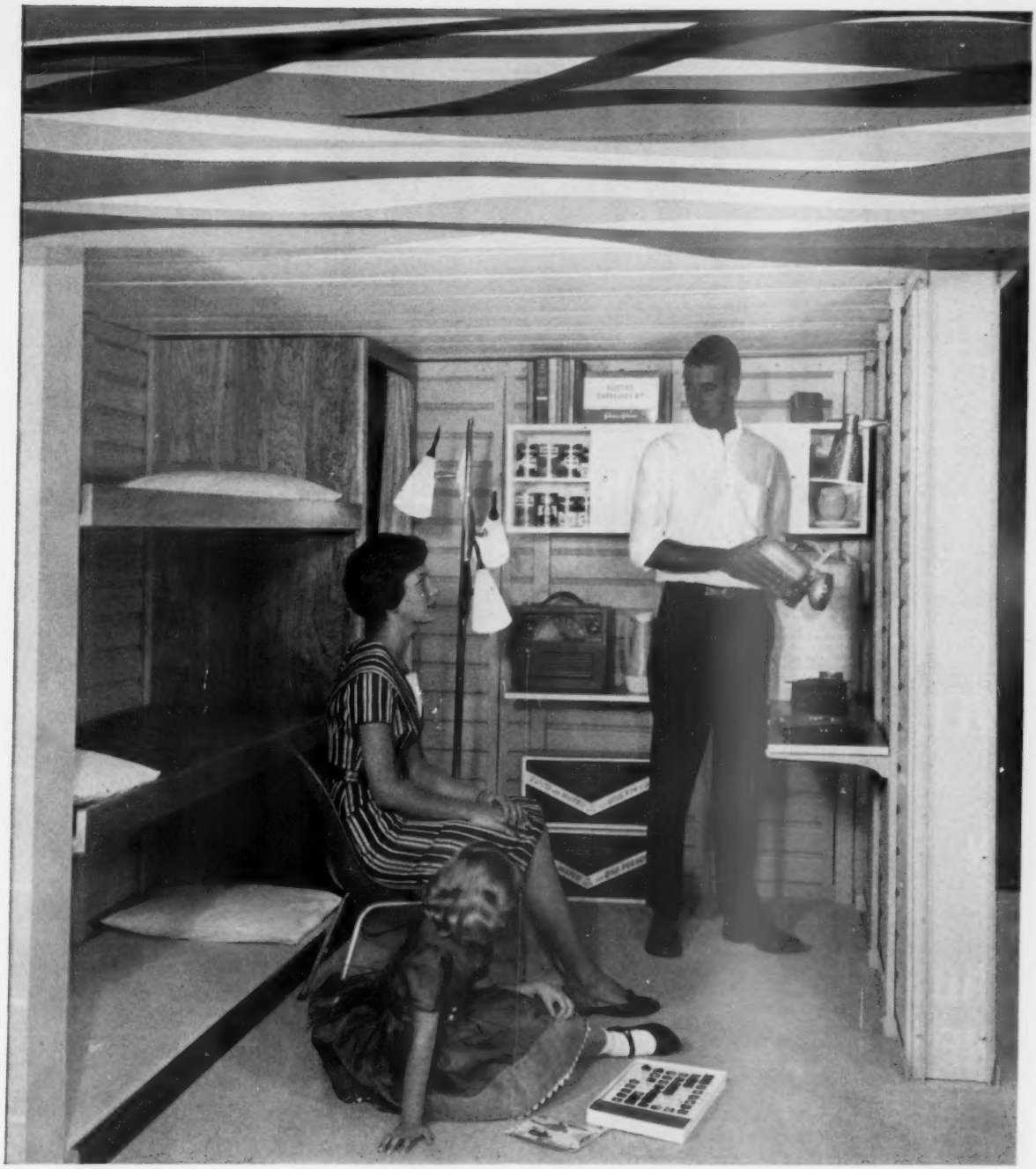

YOU CAN PROTECT YOUR FAMILY AGAINST FALLOUT

Now available is a low cost, assemble-it-yourself fallout shelter that provides vital protection against nuclear radiation. It's an all-steel panel structure that can easily be erected in any ordinary basement. Compact, the unit accommodates 6 adults but covers a floor area of only 9′ x 12′. Versatile, it can be used as a storm shelter, photo dark room, game room, or office. Developed over a period of three years in cooperation with nuclear physicists, industrial design firms and university consultants, the unit bears the seal of acceptance of the Office of Civil Defense. Produced by Heintz Division, Kelsey-Hayes Company, 102 E. Olney Ave., Philadelphia. Pa., the shelter is available through various retail outlets and local building supply dealers.

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COVER: First photo shows Hiller Aircraft Corp.'s Ten99 turbine-powered six-place helicopter, designed for service as a Navy light fleet utility helicopter, Marine Corps assault support vehicle or as an all-purpose commercial rotorcraft. Powerplant is a Canadian Pratt & Whitney PT6 turbine engine rated at 500 eshp. takeoff power (AW Nov. 6, p. 74). The production version will carry a payload of more than 1,000 lb. Cargo compartment has 100 cu. ft. capacity. The Ten99 has clamshell doors at the rear of the cabin, plus two doors on each side. The company-funded project was begun in late 1958. Hiller applied to Federal Aviation Agency last summer for type certification. The Ten99 is about 40 ft. long over-all, 10 ft. high and has a main rotor diameter of approximately 35 ft. (See p. 29 for other photos.)

PICTURE CREDITS

Cover—Henry Wichers; Hiller Aircraft; 29—Hiller Aircraft; 37—General Dynamics; 54, 55, 57—Swiss Air Force; 76, 77—Bell Helicopter; 93—Varian Assoc.; 48—Czech Airline; 105, 111—Mooney Aircraft; 121—NASA.

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Starfighters scramble on BFG fabric tread tires...

selected for ability to take 2-ton load variations, speeds to 270 mph.

A fast ship in the air, The Lockheed Starfighter is also mighty quick on the runway, with takeoff speeds ranging from 212 mph up to an extreme of 270 mph. The Starfighter's flexibility and its ability to carry heavy loads requires tires that can take two-ton load variations, and speeds up to 270 mph under adverse takeoff conditions. The BFG fabric tread design has proved it can stand up to these punishing conditions, reducing tread cutting and making tread separation virtually impossible. Multiple nylon plies are built right into the rubber tread stock. This reduces internal tread flexing and overheating. These tires are being supplied on the F104 for the U.S. Air Force, West German Republic, and Canada. For complete information, contact B.F.Goodrich Aviation Products, a division of *The B.F.Goodrich Company, Dept. AW-11A, Akron, Ohio.*

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EDITORIAL

Required Reading

We have just finished a book that should be required reading for every citizen of this nation interested in its future. It is "The Narrow Margin," written by two Englishmen, Derek Wood and Derek Dempster, and published in England, Canada and this country by the McGraw-Hill Book Co. We have read almost all the books published on the Battle of Britain from the first wartime paperback of His Majesty's Stationery Office through the post-war pilots' memoirs and the unsuccessful attempts of both U.S. and British authors to distill the essence of this battle.

"The Narrow Margin" is the first successful attempt to put the full story of the Battle of Britain between the hard covers of a book with all of its significance, ranging from the technical and political tentacles that trailed through the early thirties through the grave and significant decisions made in the heat of the battle to the nature of the final, narrow margin of victory that saved a nation.

The Battle of Britain, truly understood, has vast significance for every citizen of this nation today. For as Britain alone carried the spear that could stop the march of Nazi Germany through Western civilization in 1940, so today a similar responsibility rests on this country in the face of the Communist challenge. All the significant elements that determined victory and defeat in the Battle of Britain are present in the military equation that confronts the Western world and its Communist challengers today. This is true despite the tremendous compression of time and distance by the new weapons spawned by acceleration of a technology that was just gathering momentum when it was put to its first test in the summer of 1940 over southeastern England.

Technical Controversies Continue

The technical controversies that raged in both British and German circles during the mid-thirties over what specific lines of development to pursue still have their counterparts in the Kremlin and the Pentagon today. While their significance in the Battle of Britain has now become crystal clear, their portent for our future must again await the verdict of history. For example, in England, the battle in 1935 between eminent scientists over whether to pursue radar or infrared as the most promising solution to the problem of long-range aircraft detection was as significant to the outcome as the final chatter of machine guns between opposing Messerschmitts and Spitfires five years later. What enormous significance, in retrospect, grew from the death of the German Gen. Walter Wever in 1936. For he was the brains and backbone of the German effort to develop strategic airpower, and at the time of his death, the prototypes of the four-engined Junkers Ju 89 and the Dornier Do 19 bombers were ready for flight testing, with performance capabilities of carrying a large bomb-load to Scotland and the Urals from German bases. What would the outcome of the Battle of Britain have been if the main assault had been carried by these types instead of the lightly loaded, lightly armed and short-ranged Do 17s, Ju 88s and He 111s? German strategic airpower died with Wever and, ironically, it was Marshal Kesselring, who later made so many errors of command in the Battle of Britain, who signed the order to scrap the German four-engine bomber program.

What ad hoc committee or scientific advisory board could have made the decision, two days after a service test pilot's report, to re-equip all Merlin-powered Royal Air Force fighters with the constant-speed propeller developed by Hamilton Standard and built under license by de Havilland, and then equip over 1,000 Spitfires and Hurricanes with this vital device for high-altitude combat in less than 60 days while the Battle of Britain was in its most critical phase?

The fascinating game of electronic countermeasures, which began with the North Sea voyages of the Graf Zeppelin in the summer of 1939 and included such crude devices as hospital X-ray machines as emergency jammers, is still being fought today as one of the hottest sectors of the cold war.

Lessons From History

All of the political arguments in England over the cost of rearmament during the late thirties have the same resonance as the defense debates of the past five years. The blunders of intelligence on both sides, when Winston Churchill's network, organized as a private citizen, proved more efficient than either official British or German bureaucracy, also have current echoes. And Reichsmarshal Goering's woeful underestimate of how large a fighter force it would take to subdue the RAF Fighter Command should be studied by the Pentagon planners, who are calculating to the last fraction of a kiloton just how much is enough for any future struggle between nuclear powers.

But perhaps the biggest lesson to be drawn from this fine description of the Battle of Britain is that it was not a simple test of personal valor and skill between pilots when the battle was joined. It was a test of systems stretching back through the years when they were conceived, organized and developed, and was finally dependent on the military skill of the commanders who operated them in the months of crucial battle, and the determination and ingenuity of the economic and technical support required to sustain them.

For it is as true today as it was in the summer of 1940, when Air Marshal Sir Hugh Dowding said it, that "the war will be won by science, thoughtfully applied to operational requirements." Read the book and think!

—Robert Hotz

300,000 psi bolting...and how you can use it

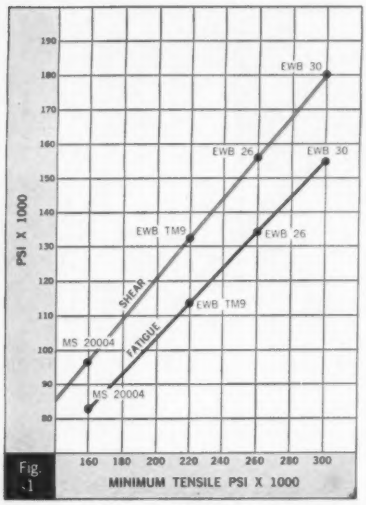


Fig. 1. Comparison of EWB 30 with predecessor bolts, showing proportionate increase in tensile, shear and fatigue.

Look back 10 brief years and you realize that in the new SPS EWB 30 you have a bolt which has actually cut the weight of steel fastening in half. Offering twice the tensile strength and three times the fatigue endurance of an MS 20004 Series, this—the first practical 300,000 psi superbolt—now pushes steel to a point comparable to titanium in the strength-to-weight spectrum.

All Physicals Upped Proportionately

Fig. 1 depicts the evolution of the EWB 30 in terms of increasing tensile, shear and fatigue values. Most significant is the fact that the EWB 30 offers a *proportionate* increase above lower strength bolts in static and dynamic strength.

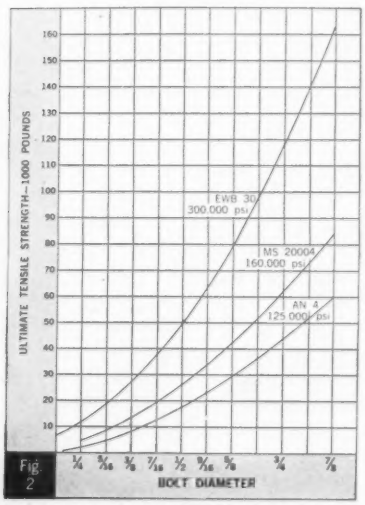
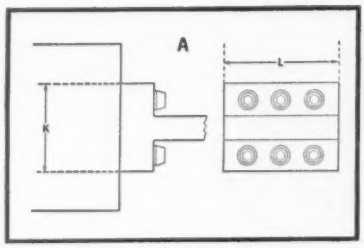


Fig. 2. Because all its physicals have been upped proportionately, you can safely use the EWB 30 in place of larger, heavier bolts.

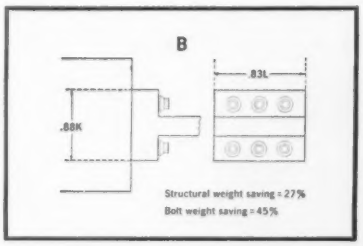
Precisely because its tensile, shear and fatigue have been increased in proportion, you can safely compare the EWB 30 with its predecessors in terms of tensile strength vs. bolt diameter. And from such a comparison (Fig. 2) you can—again safely—derive the substitution of, say, a $^{9}/_{16}$ in. EWB 30 for a ¾ in. MS 20012 at a tensile level of approximately 65,000 lb.

Weight Savings Approach 50%

Design implications of the new EWB 30 are therefore far-reaching, to say the least. As an example, take the hypothetical situation below—a simple joint fastened with six bolts. Note that in instance A we have designed around MS 20004 Series bolts; in B, around the new EWB 30.



	A MS 20008-16
Bolt diam.	½ in.
Head diam. (max.)	.828 in.
Ultimate tensile (min.)	27,400 lb
Grip	1 in.
Length	1.812 in.
Approx. weight per bolt	0.147 lb.



	B EWB 30-6-16
Bolt diam.	⅜ in.
Head diam. (max.)	.725 in.
Ultimate tensile (min.)	28,500 lb.
Grip	1 in.
Length	1.739 in.
Approx. weight per bolt	0.0805 lb.

Thus you can go from ½ in. MS 20008 to ⅜ in. EWB 30 and actually *gain* tensile strength. And because EWB 30 shear and fatigue are in proportion, you can do it without risk. Result: a reduction of .399 lb.—or approximately 45% —in fastener weight alone!

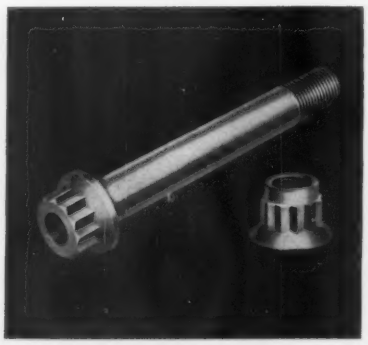
Related Components Can Be Miniaturized

Savings in fastener weight are not the only design opportunity offered by the new EWB 30. Associated components—flanges, "T" sections, etc.—can also be miniaturized. In our hypothetical joint, for example, the smaller EWB 30 permits the width of the flanged member to be reduced 12%, flange length reduced 17%. In space vehicles or missiles, where weight is of paramount importance, these small savings on large-size joints can be significant.

A Complete Fastening System

In designing with this new ultra-high-strength bolt, full utilization of the advantages can only be accomplished by proper design and installation. Thus SPS offers with the EWB 30 a related fastening system . . . a special-design socket wrench which prevents damage of the wrenching area by contacting the less vulnerable midportion of the wrenching flats; and a preload indicating washer (PLI) which assures accurate preloading to 80% of bolt yield strength.

EWB 30 bolts and companion FN 30 locknuts are available only from SPS—in sizes #10-32 to ⅞-14. Also available is a shear bolt and nut combination in protruding (EWSB 30) and flush head styles (SFT 30, SFH 30) for 180,000 psi shear strength. For more information write AIRCRAFT/MISSILE DIVISION, SPS, STANDARD PRESSED STEEL CO., JENKINTOWN 3, PENNSYLVANIA • SANTA ANA, CALIFORNIA. Warehouses: Atlanta, Ga. • Dallas, Tex. • San Diego, Calif. • Seattle, Wash. • Tuckahoe, N.Y. • Wichita, Kans.



New SPS EWB 30 bolt and companion FN 30 locknut. Tensile strength: 300,000 psi.

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where reliability replaces probability

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In the Front Office

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Kenneth F. Hallinan, vice president-marketing, Hiller Aircraft Corp., Palo Alto, Calif., succeeding **A. W. B. Vincent,** retired. Also: **William Callery, Jr.,** commercial sales manager; **Philip A. Johnston,** domestic sales manager.

T. A. O. Gross, president Spectran Electronics Corp., Maynard, Mass.

Byron L. Allison, vice president-sales, Chicago Aerial Industries, Inc., Barrington, Ill.

Richard A. Hagberg, vice president and general manager, Triad Transformer Corp., Venice, Calif., a division of Litton Industries.

Leland A. Sidwell, vice president and manager, Connector Division of Microdot, Inc., South Pasadena, Calif.

Warren E. Poitras, vice president and director of marketing, Swedlow, Inc., Los Angeles, Calif.

John H. Dummer, a vice president, International Resistance Co., Philadelphia, Pa. Mr. Dummer continues as director of foreign operations and affiliates.

Vice President **Martin E. Kagan** and Treasurer **Sandor Reich** elected senior vice presidents of Yardney Electric Corp., New York, N. Y., and Assistant Vice President **Dr. Paul Howard** elected a vice president. Also: **Benedict M. Lissim,** head of general plant administration, now vice president; also **S. Berchielli,** chief engineer, now assistant vice president and chief engineer of the company's Stonington, Conn., plant; **Frank Solomon,** head of research and development, now assistant vice president.

Dr. Hiden T. Cox, assistant administrator for public affairs, National Aeronautics and Space Administration, Washington, D. C.

Brig. Gen. David M. Jones, deputy commander for the GAM-87 Skybolt program, Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, Ohio.

Lt. Col. Wesley W. Scott, weapon systems project officer for Sergeant and Corporal missiles, Army Ballistic Missile Agency, Redstone Arsenal, Ala.

Honors and Elections

Jacques Allez of France has been re-elected president of the Federation Aeronautique Internationale, and **Dr. W. Mari** of Switzerland was re-elected first vice president. **Jacqueline Cochran,** board chairman of the National Aeronautic Assn. (AW Oct. 30, p. 19), was elected an F.A.I. vice president and board member.

Changes

Dr. Warren J. McGonnagle, assistant director, Department of Electronics and Electrical Engineering, Southwest Research Institute, San Antonio, Tex.

Carl L. Brockman, director of engineering, Gemco, Inc., subsidiary of Hupp Corp., Los Angeles, Calif.

(*Continued on page 130*)

INDUSTRY OBSERVER

► Requests for proposals for development of USAF's medium-range ballistic missile are expected to be issued to industry bidders about Dec. 1. Intense competition is expected for airframe work and solid propellant motors.

► **Proposals for a study of a three-man roving lunar vehicle have been requested by Nov. 24 by USAF's Aeronautical Systems Division. The study is expected to be small, not exceeding 5,000 man-hours of effort.**

► Bristol T.188 stainless steel supersonic research aircraft is scheduled to make its first flight next week if taxi trials, begun last week, are satisfactory. In runup tests, now completed, the T.188's two de Havilland Gyron Jr. DGJ.10 turbojets produced 14,000 lb. thrust with afterburning.

► **National Aeronautics and Space Administration has decided to scrap Project Calorie, which was to have been a re-entry heating test of several Apollo shapes launched from one Atlas-Agena B vehicle. Shapes would have been arranged around the Agena stage and propelled one by one on re-entry trajectories. First flight would not have occurred for 18 months. Instead, NASA will test the re-entry shapes individually, using smaller launching vehicles, to supplement shock tunnel tests at re-entry velocities.**

► Some observers of the USAF-North American B-70 supersonic bomber program foresee difficulties in obtaining expected values of two key technical parameters—lift-drag ratio and pressure recovery at the engine inlet, which is now calculated as 90%. Failure to match calculated values of either would cause large performance losses. Current estimates for the B-70 show a gross takeoff weight of 550,000 lb.

► **Radioisotope altimetry techniques that could lead to a series of aerospace devices for measurements at high altitudes will be investigated under a forthcoming Aeronautical Systems Division study. Requests for proposals were circulated to avionic firms recently. Study will cover scattering, transmission and attenuation of radioisotopic particles.**

► Canadair CL-41 two-place basic jet trainer has flown Mach .775 in level flight, exceeding the Royal Canadian Air Force requirement of Mach .75.

► **Chrysler Corp. intends to organize a new Space Division under its Defense and Special Products Group if it wins either of the Saturn booster fabrication contracts, rather than handle the work through its Missile Division.**

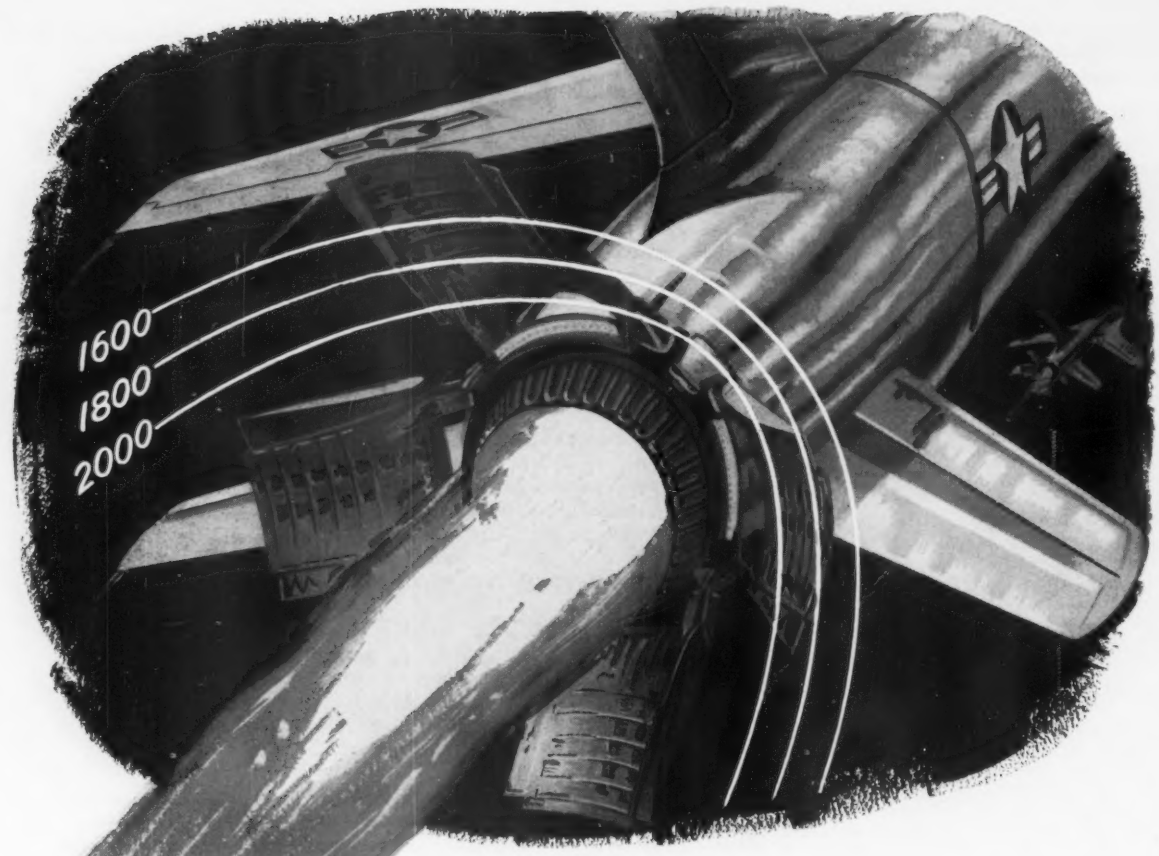
► Navy's Bureau of Weapons has postponed the date for submission of proposals for the VAX close-support fighter based on funded studies by North American, Douglas and Boeing. Companies have been told to continue their investigations. Proposals originally were due on Nov. 15.

► **Armour Research Foundation is soliciting support among avionic semiconductor component manufacturers for a long-range, cooperatively-financed research program to explore possibilities of obtaining useful devices from organic semiconductor materials.**

► Payload for USAF's proposed Slam nuclear-powered ramjet missile, designed to cruise at Mach 3 at very low altitudes, includes 16 type B nuclear weapons.

► **Cost estimates on orbital Dyna-Soar boost glider flights, using the Titan III as a booster (AW Nov. 6, p. 26), are due to be submitted to USAF on Nov. 13 by Boeing Co. Defense Department's failure to accept the proposed acceleration of Dyna-Soar under Project Streamline has resulted in a substantial cutback in Boeing engineers on the project.**

► Pad 75-1 at Vandenberg AFB, Calif., will be modified to handle USAF and NASA Thor-Agena vehicles. USAF prefers horizontal assembly but NASA prefers vertical assembly, using a mobile gantry.



Braking 23 Tons at 1200 MPH

Few brakes are called upon to take such a beating. That's why HAYNES alloy No. R-41 was selected for all critical areas of the petal-type speed-brake on the Air Force's new F-105 Thunderchief fighter-bomber.

Closed, the tail-mounted "petals" encircle the flaming gas blast behind the J75 engine's afterburner. Then, tremendous stress loads and thermal shock are imposed as the searing-hot doors whip open into the cold airstream—to check the blazing speed of the 23-ton, Mach 2 fighter.

HAYNES high-temperature alloys that resist temperatures of 1700 deg. F and over—for long periods and under great stress—today serve many hot spots. Resistance to stress, to thermal shock, to corrosion, erosion, and fatigue, are typical properties that make these alloys so extremely useful in turbojet engines, in ramjets, missiles, rockets, manned space capsules.

Whether investment- or sand-cast, rolled, wrought, vacuum melted, or air melted, there's a HAYNES high-temperature alloy to meet your needs.

Mechanic adjusts hinge of speed-brake door whose critical parts are of HAYNES alloy No. R-41.

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Washington Roundup

More Defense Dollars

President Kennedy has confirmed that his Administration will ask Congress for a larger defense budget next year than the $47 billion appropriated for the current fiscal year. The President did not specify the amount, which is expected to be about $50 billion (AW Oct. 16, p. 34). He told a press conference last week, in effect, that he stands by statements he made during the election campaign about the relative weakness then of U.S. defenses compared with Russia's, and that he also stands by his recent remark that the U.S. would not now trade places with anyone—chiefly because of steps taken since January to strengthen this country's position.

House Armed Services Special Investigations Subcommittee has broadened its interest in non-profit organizations to include a look at what safeguards exist to keep employes from using inside military information for stock speculation, and whether scientists serving on defense advisory boards profit directly in their business or university jobs from the advice they have given the government. Chairman Edward Hebert already has indicated he is interested in resuming hearings on non-profit groups that perform research for the Defense Department (AW Oct. 30, p. 26).

Federal Aviation Agency has gone as far as considering dropping its financial support for the Radio Technical Commission for Aeronautics, but will do nothing until it sees whether RTCA makes any changes as a result of FAA Administrator N. E. Halaby's recent warning that the organization may have outlived its usefulness (AW Nov. 6, p. 29). A letter declaring the intention to withdraw support was prepared for Halaby, but was not signed.

Soviet Marshals' Status

At a time when the U.S. seems to be downgrading the part that active military leaders play in national policy-making, Russia has included its top aircraft, missile and air defense marshals in its top political body, the Communist Party Central Committee. Military representation in the 175-man body, formerly open only to top defense ministry officials, has been increased from 4 to 12 and now includes some service and branch commanders. Aviation Marshal K. A. Vershinin, commander of the Soviet air forces, was elected to full committee membership, and his deputy, Aviation Marshal S. I. Rudenko, and Aviation Marshal V. A. Sudets, commander of Soviet strategic air forces, were elected as candidate members. Marshal Kiril S. Moskalenko, commander of strategic rocket troops, was re-elected to the committee and Marshal Serge S. Biryuzov, commander of anti-aircraft defenses, was elected to full membership.

Primate Obfuscation

Defense Department continues to shy away from talking about space flights using animals, even when this leads to obfuscation of the record. For almost a week, it prohibited Air Force from commenting on published reports that a monkey would fly aboard an Atlas. Early stories said the monkey was a Rhesus—a delicate point in relations with India, which considers this species sacred—and that telemetry sensors should be implanted in its body—a sore point with animal lovers. Actually, it was a 1.5-lb. squirrel monkey with no sensors implanted, but scheduled to fly unrestrained so films of the effects of weightlessness could be made.

Defense finally was forced to allow a press conference, with all information ordered held until the flight was made. Meanwhile, the civilian space agency was releasing information and photographs of an animal that is supposed to circle the earth three times Nov. 14 in a Mercury-Atlas launching. The animal is a chimpanzee—provided by the Air Force.

Military Space Role

One of the hottest current Pentagon political topics—the military role in space—got a thorough airing at an Air Force Scientific Advisory Board meeting last week. Each of the services detailed its own interests in space and a Defense Department representative told what the civilian leaders think about military space missions. A National Aeronautics and Space Administration official described the civilian program, and Dr. Herbert Scoville, Jr., assistant director for scientific intelligence at Central Intelligence Agency, briefed the group on the Soviet space program. The board also discussed two other areas that have been points of friction between the civilian agency and the military—the Golovin Committee report on large launch vehicles and Air Force and NASA bioastronautics programs.

Several bidders for development of the Apollo three-man spacecraft are prepared to establish new company divisions if they win. At least one firm has told NASA it would spend up to $76 million to build new facilities at any location NASA chooses. Management structure is emerging as one of the most important points in contractor selection, and NASA required bidders to specify key managers by name.

FAA Administrator N. E. Halaby, taxiing an FAA Gulfstream to fly to the scene of an Imperial Airlines crash at Richmond, Va., last week, scraped wingtips with a United Air Lines Viscount as it awaited takeoff clearance at the Washington airport. He continued his trip in a DC-3.

—Washington Staff

U.S. Skeptical of Satellite Ownership Plan

Government has 'innumerable' other ideas in mind for operation of commercial communications system.

By Katherine Johnsen

Washington—Kennedy Administration is highly skeptical of the plan for development, construction, and operation of a communications satellite system by a non-profit company that has been proposed by an ad hoc group of 10 international common carriers appointed by the Federal Communications Commission (AW Oct. 23, p. 28).

The two major developments at hearings before the Senate Small Business Subcommittee on Monopoly last week were:

- **Dr. Edward C. Welsh,** executive secretary of the National Aeronautics and Space Council, disclosed that the council is considering "innumerable" alternatives to and variations in the plan recommended by the ad hoc group.
- **Lee Loevinger,** assistant attorney general in charge of the anti-trust division, told the Senate subcommittee that the plan "is not adequate to meet the requirements" of present anti-trust law.

Development Not Delayed

Both Welsh and Loevinger indicated that it will take the Administration considerable time to evolve its position, which involves approval at the cabinet level and by the President. Welsh stressed that the absence of a decision on management of an operational satellite communications system "has not and should not" affect progress in development of this type of satellite.

Meanwhile, several aerospace firms and domestic common carriers were expected to file comments or protests on the ad hoc group's plan by the Nov. 12 deadline set by Federal Communications Commission. Western Union Telegraph Co., a member of the ad hoc group, already has filed a dissent.

Sen. Russell Long (D.-La.), subcommittee chairman, insisted at the hearings that American Telephone & Telegraph Co. would dominate the satellite communications system under the non-profit company plan.

Loevinger concurred with the approximation of the subcommittee's counsel, Benjamin Gordon, that under this plan, AT&T would have 84% of the ownership of the system, 85% of the use, plus the potential for additional financing.

Loevinger also told the subcommittee that the non-profit company—on which AT&T would have a minority representation of two members of the board of directors—would perform "no significant function," have "no real powers of control, would have no rate structure, no ownership whatever." He said it would be "just a clearing house for coordination."

Supporters of the ad hoc group's plan maintain that the fact that AT&T would have a representation of only two on the board out of a total of 14 to 18 assures against single company dominance of the system. Membership on the board would be limited to international common carriers. Each carrier investing $500,000 or more would have two representatives. Carriers not investing but leasing facilities collectively would be allowed one board member. There also would be three public members appointed by the President.

Noting that an estimated 80% to 95% of the cost of developing a satellite system will be related to the launch aspects, Sen. Long called for management participation by aerospace firms. He said the reason AT&T is in a position to finance extensively the development of the system—and aerospace firms are not—is that AT&T is a public utility that can reserve a 6% profit on investment and then pass the cost onto telephone users. The issue, as Sen. Long saw it, is whether the public will finance the development via the tax route or via the telephone bill route.

Loevinger commented that the "inference" of the ad hoc group's plan is that "the AT&T investment could become part of its rate structure."

Saturn Booster Bids Submitted

Huntsville, Ala.—Bids to develop, fabricate, assemble and test the S-1B booster stage of the Saturn C-4 vehicle were submitted to the Marshall Space Flight Center last week by Aerojet-General, Boeing, General Dynamics/Astronautics, Martin and Space Technology Laboratory. Announcement of a contract award for fabrication of the S-1 booster of the Saturn C-1 configuration was expected either late this week or early next week.

Bids for this S-1 stage, which was split from the S-1B procurement (AW Sept. 18, p. 26), were submitted by Avco, Boeing, Ford Aeronutronic, Chance Vought, Chrysler Missile Division, Northrop and Lockheed. With the technical and management evaluations of the S-1 bids completed, a source selection board met at Marshall last Wednesday and was expected to forward its recommendations to National Aeronautics and Space Administration headquarters within several days.

In other Saturn developments last week, Konrad K. Dannenberg, Marshall Space Flight Center, told Aviation Week that anti-sloshing baffles will be relocated in the tanks of the S-1 design to a point closer to the base of the tankage, starting with booster SA-5, to eliminate the oscillations induced by fuel sloshing during the flight of Saturn SA-1 (AW Nov. 6, p. 30). He said an electrical filtering system also will be added to the S-1 design, again starting with booster SA-5.

Dannenberg also said that with upper stages pacing the Saturn program, no acceleration of the over-all program is possible before mid-1963. And to reach that point of possible acceleration, he said, "everything from now to then must click perfectly."

Dannenberg said that if the Pratt & Whitney LR-115 liquid hydrogen engine again developed problems and its operational date started to fall back toward that of Rocketdyne's 200,000 lb. thrust J-2 liquid hydrogen engine, then the National Aeronautics and Space Administration might consider replacement of the six LR-115s, totaling 90,000 lb. thrust, in the Saturn S-IV stage with a single J-2, perhaps scaled down to a lower thrust figure.

Describing the proposed Y-1 liquid hydrogen engine of 1.5 million lb. thrust (AW Oct. 16, p. 23; Oct. 23, p. 27) as having a "very high growth potential," Dannenberg said that the powerplant might be used in a future modified Saturn S-II stage and that NASA has instructed North American Aviation, builder of the stage, to keep the design sufficiently flexible to accommodate possible modifications. The Y-1, he added, might also be used in a clustered booster configuration that would be "a completely new design."

Dannenberg said that the two-stage—S-I and S-IV—configuration of the Saturn C-1 launch vehicle can put "slightly more pounds in orbit" than a three-stage C-1, with S-V as the third stage, because the S-V "duplicates too much and contributes too little to the over-all mission of this particular configuration." As presently scheduled, the S-V will be used on the C-1 vehicle only for escape missions.

Aerospace Firms Report Increased Earnings

Boeing Co. increased its quarterly dividend from 40 to 50 cents a share last week and two other major aerospace companies reported improved sales and earnings for 1961 fiscal year.

Boeing reported nine month figures—sales of $1,309,259,940 and earnings of $26,072,954 or $3.27 a share. With profits exceeding last year's comparable figures by $10 million, partly due to earnings contributed by the commercial jet 707 and 720 programs after earlier losses, and with prospects of earning $.50 a share this year, Boeing directors voted the dividend increase.

Boeing's third quarter backlog was $1,975 million, a drop of $200 million from the second quarter. Commercial orders made up $1,003 million of the total.

The year-end reports:

- **North American Aviation reported earnings of $27,750,137 or $3.38 a share on sales of $1,265,445,267 for the year ended Sept. 30. Last year it earned $23,394,548 or $2.87 a share on sales of $964,162,496. Year-end backlog was $931 million.**
- **Northrop Corp., which has increased earnings as sales fell in recent years, reported both sales and earnings rose for its fiscal year ended July 30. Fiscal 1961 sales totaled $267,454,965 compared with $233,679,427 the previous year, and net income of $8,673,321 or $4.22 a share compared with $7,740,219 in Fiscal 1960. Backlog as of Aug. 27 totaled $293 million compared with $309 million the year before.**

Throughout, he observed, the ad hoc report presented "generalities and omissions. This, of course, was due to the great effort to get the broadest support."

Asked specifically by Sen. Long if AT&T would made 6% profit after taxes whether launches failed or succeeded, Loevinger said "that would appear to be the case." If aerospace manufacturers invested money, "they would just lose money" if there were failures, Sen. Long said.

Loevinger assured Long that "it is still our position" that "no single company should dominate" the satellite communications system.

Welsh told the subcommittee that "the concentration of economic power which now exists in our communications business should not be enhanced by the introduction of communications satellites." The concentration should be lessened, he said, "if this would not impair service."

European Space Group Plans 1965 Launching

London—Delegates from nine nations last week agreed on a tentative European space plan for commercial satellite launchings, setting 1963 as the date for the first de Havilland Blue Streak firing, and 1965 as initial satellite launch.

Draft convention to form a joint launcher organization will be presented to various governments, with a reporting date to Britain and France, the organizers, asked for Nov. 27 at the latest.

Unknown factor is the reaction from three uncommitted nations—Sweden, Norway and Switzerland—but one draft decision gives an indication of a broadening of design and building of the third stage, assigned to West Germany some time ago.

Newest development is the plan to have the third stage developed under the leadership of West Germany. Minister of Aviation Peter Thorneycroft said resources of all the member nations would be involved in this stage. Sweden, for one, feels it should have a part in this design. Second stage will be the French Veronique, under existing plans.

Convention also made provisions for an advanced research study department which, in the first two years of the initial program, will establish proposals for the Eurospace teams second program. (The first is aimed at putting a communications satellite in orbit and scientific probes.)

An informal group, Thorneycroft said, is already at work to prepare the organizational setup, pending decisions of the various governments. If approved, the space team will be headed by a council consisting of representatives from each of the member governments. Council will appoint a senior staff, directed by a secretary-general—responsible to the council for the programs.

Allocation of space contracts will be determined by the organization on the basis of a rational distribution of work among the member states. In addition, each member country will join in the scientific, engineering and planning activities of the over-all organization.

Fate of Blue Streak now rests on the decisions of the other governments. First scheduled firing was to have taken place in 1962, but that slipped badly when the British government shelved much of its financial support. The rocket has been static test-fired a number of times at Spadeadam test facility.

Delegates now reporting to their governments are from Australia, Belgium, Denmark, The Netherlands, Federal Republic of Germany, Italy, Spain, besides the three uncommitted nations. France and Great Britain were hosts.

Messerschmitt Has First Postwar Profit

Augsburg—Messerschmitt AG, a leader in the reviving West German aircraft industry, showed a profit for the first time since World War II during its recently ended Fiscal 1960 year and proposed a 9% dividend payment to stockholders, also a postwar first.

At a general meeting here, company spokesmen said Messerschmitt managed to balance its books in Fiscal 1959, moved into the black in 1960 and "apart from a few matters . . . the effects of the war and postwar years have been overcome."

Net profit for the year was reported at approximately $255,000, of which $234,000 will be used to pay dividends to shareholders of the outstanding stock with a total value of about $2.6 million. The company's registered capital, including statutory and free reserves, now amounts to approximately $3 million.

Company statement said that the 9% dividend figure had been decided upon since there have been no previous payments "for the last 20 years."

In addition to major component manufacturing for the F-104G and the Fiat G.91, the firm said it also is interested in the manufacture of civil aircraft and noted that the West German industry has "endeavored to induce the federal government to follow the custom practiced in other countries by promoting and encouraging construction of civil and sport aircraft—a matter in which we have no small interest."

PERT Evaluation

Air Force committee, constituted to examine best features of various program evaluation review techniques (PERT) is scheduled to submit its report by Mar. 1 to Deputy Commander for Aerospace Systems, Air Force Systems Command. Committee job will be to review and consolidate best features of these PERT techniques:

- **The Operational PERT System (TOPS) formulated for space and satellite programs at Aerospace Corp., but primarily aimed at USAF Space Systems Division's Samos reconnaissance program.**
- **System being developed by Operations Research, Inc., Santa Monica, Calif., for USAF Ballistic Systems Division's Minuteman ICBM site installations.**
- **PERT technique applied to USAF Aeronautical Systems Division's Douglas Skybolt air-to-ground missile.**

Industry observers have commented that this approach for standardization should be taken a step farther by DOD to create a single technique to function for Navy, Air Force, Army and NASA.

TFX Fighter Award Due Feb. 1

Washington—Award of a contract for development of the TFX tactical fighter for the Air Force and Navy will be made by Feb. 1. Contractors who submit proposals by the Dec. 6 deadline will be allowed one hour each for oral presentations on Dec. 12 and 13.

Military specifications accompanying proposal requests from the USAF Aeronautical Systems Division clearly delineate two separate aircraft differing in size and performance requirements for Air Force and Navy missions.

A two-engine aircraft is specified, with the notation that the engines currently considered as meeting requirements are the Pratt & Whitney TF-30, the Allison AR168 and the General Electric MF295 (AW Oct. 16 p. 34).

In order to meet performance specifications, the document states that the variable geometry wing is probably necessary but not mandatory. The aircraft must have all-weather capability.

It must be capable of operating from a pierced metal plank or sod field. Deceleration in field operations may be provided by thrust reversal methods, drogue parachute or other method which a contractor may develop.

Air Force requirements call for a 60,000-lb. aircraft with length not specified. General belief is that it will be from 73 to 76 ft. long. Takeoff and landing must be limited to 3,000 ft. or less. Combat radius for a low approach, high-altitude delivery and low-altitude escape is set as 800 naut. mi. Ferry range required is 3,300 naut. mi.

USAF also wants a speed capability of Mach 2.2 cruise at 60,000 ft. and a high speed of Mach 2.5. For low-level missions a speed range of Mach 0.9 to Mach 1.2 for 100 naut. mi. is stated.

Navy has specified speeds of Mach 1.0 at sea level and Mach 2.0 at best altitude, which is conceded to be about 60,000 ft. It must be able to carry six 1,000 lb. bombs for a combat radius of 150 naut. mi. and be able to loiter on station for 3½ hours. Length is to be 56 ft. and gross weight 55,000 lb.

Navy also requires provisions for catapult launching and arrested landings. Full service must be possible from aircraft carriers of the CVA-59 (Forrestal class), CVA-43 (Coral Sea), and CVAN-65 (Enterprise). Limited service—emergency landings must be possible for CVA-41 (Midway), CVA-42 (Franklin D. Roosevelt) and the CVA-19 (Hancock class), which is also called the 27C conversion of the basic Enterprise class carrier. The Coral Sea would have TFX operational capability because its angled deck used for landings is 664 ft. long, only 19 ft. less than the Forrestal class. It also has stronger catapults and arresting gear than the other two ships of the Midway class.

British Aircraft Industry Workers Agitate for Government Backing

London—British aircraft employes participated in a one-hour sit-in strike recently protesting "lack of government support" of the British aircraft industries, and the supersonic transport in particular, while delegates from 20 factories met with members of Parliament.

About 9,000 members of the Assn. of Supervisory Staffs, Executives and Technicians took an hour off at their desks. Upshot of the protest was that the Labor Party will schedule a House debate on arguments for building a supersonic transport.

Strike by the technicians was another barb at lack of government support of the aviation industry. More striking was the recent disbanding of the Hawker Siddeley Group's space research team after two fruitless years of trying for government contracts.

Hawker Siddeley employs about 125,000 persons, of which 70,000 are involved in aircraft production. But dropping its space research team was only part of the picture: the group has had one new airplane sale in three months, a lone Dove. Meanwhile:

• **De Havilland's** Portsmouth plant, which does subassembly work on the Comet and Sea Vixen, is shutting down, putting nearly 1,500 employes out of work. Only the machine shop will remain in operation for Trident transport work.

• **Cutback also is in store** for de Havilland's Chester plant, which assembles Doves and Herons and does Comet subassembly work. Problem is not so severe at de Havilland's main Comet assembly plant at Hatfield, where workmen will be phased into the Trident program when Comets eventually leave the production line.

• **Gloster Aircraft,** which has been merged with Armstrong Whitworth, has laid off 300 persons in two weeks, mostly at the main works at Gloucester. This plant has mostly been converting Javelins to Mk. 9 configuration (afterburning and hardware for in-flight refueling) and performing some subcontract work within the group.

Hawker Siddeley currently is building the Armstrong Whitworth 660 for the Royal Air Force, the Vulcan V-bomber, Blackburn NA.39 for the Royal Navy, 24 Tridents for British European Airways, and the Comet 4 and Sea Vixen. Some of these plants will absorb men laid off at others, company says.

Policy Talks

Top executives at Hawker Siddeley and other aircraft groups are known to be considering high-level talks with government officials, to set down a policy plan for the British industry, based on a market survey of its potentials. Important decision will be the amount of government support in financing research and development. Thus, the companies will build the product, giving the government a percentage of profits.

At the moment, Hawker Siddeley prefers to say that it is assessing its operations with a view to streamlining and is trying to achieve efficiency by adapting the labor force to current conditions.

Last July, Sir Thomas Sopwith, group chairman, told stockholders that the group had written off $42 million on civil aircraft design and development and said at that time that Hawker Siddeley needed government support for future projects.

White Paper Blamed

Privately, industry executives lay much of today's ills on the often-denounced defense White Paper of April, 1957, when the then Minister of Supply Duncan Sandys said the U.K.'s future policy would stress rocket and missile defenses, and the government was dropping development of a manned supersonic bomber. Fighters would be replaced by a ground-to-air missile system.

After that, Sandys became the architect of the grouping of the industry, mostly into Hawker Siddeley, British Aircraft Corp. and Westland. But Blue Streak was dropped as a weapon, Douglas Thors became the missile deterrent, and the V-bomber force remained the airborne nuclear deterrent.

Only two fighters are under development—the Hawker Siddeley P.1127 VTOL for the NATO competition, and British Aircraft Corp.'s TSR.2 strike fighter. Royal Air Force is considering designs for a tactical transport replacement for the Beverley, but Treasury has not yet made any funds available for production.

Hiller Displays New Six-Place Helicopter

Hiller Aircraft Corp.'s newly displayed six-place turbine helicopter incorporates tail boom (top), from H-23/UH-12 series, including anhedral stabilizers from Hiller H-23F/E4 aircraft. Photo at right shows Pratt & Whitney PT6 turbine engine rated at 500 eshp. takeoff power. All glass fiber access panels can be removed or opened on hinges. Topside access is provided by special maintenance platform built into the sides of the aircraft, which fold flush in flight. Clam-shell doors (bottom left) are for aft loading. Box-like cargo compartment has 100 cu. ft. of loading area. Diagonal structural members would be eliminated in production aircraft. Basic Ten99 configuration was demonstrated privately to military in mockup two years ago—the mockup program was known as CAMEL. For other details see p. 19.

U.S. Plans to Control Space Dollar Impact

By George C. Wilson

Washington—Kennedy Administration is pushing the nation's space program into a new phase by looking beyond technical and organizational problems and trying to spend the billions of dollars involved in such a way that they will broaden the political and industrial support for space exploration.

In doing this, space leaders are making policy decisions that will change the government's relationship not only with the aerospace industry but also with colleges and universities for the next decade.

Major Test Coming

Basic impetus for trying to involve a far larger proportion of the nation in the space program is the fear that enthusiasm for it will slacken once the true costs are realized. Significantly, Administrator James E. Webb of the National Aeronautics and Space Administration last month said the big test will come next year when Congress is asked to appropriate about $3.5 billion for space—or twice NASA's current budget. This year's $1.7 billion NASA appropriation is a down payment on a 10-year space program estimated to cost between $33 billion and $50 billion.

Another motive is to develop the technological depth for what looks like a longer and faster-paced space race with Russia than the Eisenhower Administration envisioned. Policy makers feel such depth, besides its long-range advantages, will ensure maximum value from whatever money Congress does appropriate for space over the next few years. Accordingly, the Kennedy Administration has made the basic decision to spread its space contracts widely rather than concentrating on a few companies or geographical areas.

The effort under way to broaden political support for the space program employs a variety of techniques—some old, some new. Basically, the idea is to exploit the direct impact of space spending as much as possible and at the same time stress the indirect benefits coming to the nation from the program. The danger in this approach—as in all public works programs—is that political considerations might outweigh scientific ones.

In the last few months, NASA has announced it will expand launching areas at Cape Canaveral, Fla.; renovate an Army ordnance plant at Michoud, La., to serve as the fabrication center for Saturn and other large boosters, and build its Manned Spacecraft Center at Houston, Tex.

To some observers, the selection of Michoud, La., looked like a favor to the late Rep. Overton Brooks (D.-La.), who was then chairman of the House Science and Astronautics Committee which handles NASA legislation. But as a matter of fact, Rep. Brooks did not want the fabrication center there because Michoud is in the congressional district of an old rival, Rep. F. Edward Hebert (D.-La.) NASA defended the site on the grounds it was convenient to Marshall Space Flight Center at Huntsville, Ala., which directs large booster development, and had the all-important access to the sea so the rockets could be moved to the Florida launch site by barge.

Houston Decision Controversial

Selecting Houston for the Manned Spacecraft Center prompted stiffest charges of "politics" to date. Although Houston has access to the sea, it is not as convenient to Cape Canaveral as

Firms Receiving Largest NASA Contracts, FY 1961

National Aeronautics and Space Administration in Fiscal 1961 spent $756 million on research and development. Of this amount, private business received $423 million, or 56%; other government agencies, $222 million, or 29%, with the Air Force receiving $142 million, or 64%, of this amount; Jet Propulsion Laboratory, $86 million, or 12%; universities and other non-profit institutions, $25 million, or 3%. This listing shows organizations which received the largest NASA contracts in Fiscal 1961.

	Thousands of Dollars	% Industry Total	Number of Contracts
Private Contractors			
North American Aviation, Inc.	$75,009	18	21
McDonnell Aircraft Corp.	41,843	10	4
Douglas Aircraft Co.	30,698	7	8
Western Electric Co.	26,609	6	3
Space Technology Lab.	13,098	3	11
Chrysler Corp.	12,922	3	9
Grumman Aircraft Eng. Corp.	11,168	3	3
The Hayes Corp.	10,278	2	4
General Electric Co.	9,197	2	30
Chance Vought Corp.	8,773	2	12
Radio Corp. of America	8,580	2	31
Brown Engineering Co.	6,680	2	2
Bendix Corp.	6,481	2	16
Aerojet-General Corp.	6,286	1	14
Lockheed Aircraft Corp.	3,335	1	13
Minn. Honeywell Regulator Corp.	2,730	1	14
Norair Engineering Corp.	2,512	1	3
General Dynamics Corp.	2,135	1	17
Flexonics Corp.	2,128	1	2
Ball Brothers Research Corp.	2,025	*	4
United Eng. & Constructors, Inc.	2,000	*	1
Collins Radio Co.	1,994	*	3
Arthur Venneri Co.	1,969	*	1
Carl N. Swenson Co.	1,835	*	3
Ampex Corp.	1,685	*	20
Other	131,324	30	**
Total	$423,294	100	

* Less than 1%.
** Not available.

	Thousands of Dollars	% Industry Total	Number of Contracts
Educational and Non-Profit Organizations			
Research Contracts			
Mass. Institute of Tech.	1,876	14	5
Univ. of Michigan	1,400	10	8
Univ. of New Mexico	1,204	9	4
Univ. of Alaska	675	5	1
Cornell Aeronautical Lab.	607	5	3
Rand Corp.	585	4	2
Battelle Memorial Institute	540	4	5
Stanford Research Institute	460	3	3
Princeton University	450	3	3
State University of Iowa	406	3	1
Other	5,470	40	**
Total	$13,673	100	
Research Grants			
Smithsonian Institution	4,595	42	2
Univ. of California	1,202	11	10
Leland Stanford, Jr., Univ.	647	6	4
Rensselaer Polytechnic Institute	441	4	3
Princeton Univ.	386	4	2
Rice Institute	300	3	1
Florida State Univ.	270	2	2
Univ. of Cincinnati	249	2	2
Pennsylvania State Univ.	238	2	3
Calif. Institute of Tech.	207	2	2
Other	2,337	22	**
Total	$10,872	100	

States Which Received NASA Contracts

National Aeronautics and Space Administration in Fiscal 1961 distributed its contracts among 38 states and the District of Columbia. Idaho, Kansas, Maine, Mississippi, Montana, Nebraska, North Dakota, South Carolina, South Dakota, Vermont, West Virginia and Wyoming did not receive a NASA contract of $25,000 or more in the fiscal year ending June 30, 1961. This chart shows all the NASA direct procurement contracts of $25,000 or more to U. S. industries. Contracts with other government agencies and awards made outside the U. S. are not included. The right hand column shows how the states ranked by dollar amounts of contracts. (District of Columbia, if counted as a state, would rank 12th).

	Contract Actions		Net Value of Awards		
State	Number	% Total	Amount	% Total	State's Rank
Alabama	123	9	$37,130,135	10	4
Alaska	2	*	675,000	*	24
Arizona	8	1	401,664	*	25
Arkansas	1	*	25,289	*	38
California	353	25	148,713,264	39	1
Colorado	17	1	2,567,264	1	17
Connecticut	33	2	3,165,039	1	15
Delaware	1	*	44,908	*	34
Florida	48	3	5,062,539	1	12
Georgia	20	1	2,920,504	1	16
Hawaii	2	*	159,944	*	28
Illinois	36	3	3,872,223	1	14
Indiana	12	1	1,054,750	*	20
Iowa	5	*	679,343	*	23
Kentucky	1	*	31,611	*	35
Louisiana	2	*	79,373	*	32
Maryland	86	6	12,939,621	3	5
Massachusetts	84	6	8,007,841	2	10
Michigan	35	2	3,888,926	1	13
Minnesota	17	1	1,824,833	1	18
Missouri	22	2	42,427,624	11	3
Nevada	1	*	50,000	*	33
New Hampshire	1	*	29,192	*	36
New Jersey	74	5	11,893,353	3	7
New Mexico	8	1	1,302,365	*	19
New York	91	6	43,871,951	12	2
North Carolina	4	*	135,917	*	29
Ohio	82	6	8,135,593	2	9
Oklahoma	7	*	337,210	*	26
Oregon	3	*	200,372	*	27
Pennsylvania	65	5	11,443,294	3	8
Rhode Island	2	*	83,087	*	31
Tennessee	10	1	948,764	*	21
Texas	67	5	12,179,820	3	6
Utah	1	*	28,420	*	37
Virginia	65	5	6,830,483	2	11
Washington	1	*	98,503	*	30
Wisconsin	8	1	705,093	*	22
Wash., D. C.	27	2	6,230,551	2	
Total	1,425	100	$380,175,663	100	

* Less than 0.5%.

Langley Field, Va., or Tampa, Fla., which also were considered for the center. The Houston site borders on the congressional district of Chairman Albert Thomas (D.-Tex.) of the House appropriations subcommittee which rules on NASA's budget. He is in a key spot to help or hurt NASA and made no secret of the fact that he would be bitterly disappointed if the space flight center did not go to Houston. The furor which erupted when Houston won out over other cities illustrates that NASA cannot depend on its building program alone to broaden political support for space, especially since opposition to space spending is growing as election year 1962 approaches.

Consequently, space leaders in this new phase are stepping up their sales effort, both within government and at the grass-roots level. NASA's recently issued Fiscal 1961 procurement report, for example, declares that the space agency is "keenly aware" of its obligation to help small business and labor-surplus areas of the country "to the maximum extent possible." The report lists the 38 of the 50 states which got space dollars, a listing that cannot help but impress politicians (see accompanying chart).

Grass-Roots Approach

Chairman Robert S. Kerr (D.-Okla.) of the Senate Aeronautics and Space Sciences Committee exemplified the approach being taken at the grass-roots level recently when he told the Oklahoma Savings and Loan League that space money "including sending a man to the moon and back safely . . . will be spent here on earth—in this country mostly. Many Oklahomans will have an opportunity to participate in the economic growth it will inspire as more and more new products—many of them far less dramatic than space exploration itself—come into production as a result of this scientific and technological revolution."

Vice President Lyndon B. Johnson, chairman of the National Aeronautics and Space Council, also is busy selling space exploration as a critical national program. He recently toured half a dozen major space installations, and told the people there that President Kennedy was counting on them and was deeply appreciative of their contribution to the nation.

Although the remarks were aimed at those working directly in the program, Johnson's trip was intended to dramatize for the nation the Kennedy Administration's enthusiasm for space exploration. Johnson claimed that "there is not any subject President Kennedy is more interested in or has given more attention to than space."

The Vice President also indicated the Administration was keenly aware of the geographic impact of the space program and was determined to exploit it. In applauding NASA's selection of Houston for the Manned Spacecraft Center rather than such a city as Boston, which also bid for it, Johnson said: "Just because a man can afford to send his son to an Ivy League college, that's no reason for that area to get all the benefits" of space installations. Johnson said the concentration of space work in the Southwest would stimulate technical growth there, and contended this spread of industrial strength would benefit the nation as a whole.

Although Johnson's view is that of a politician, it is supported by several leading government economists who now are studying the impact of the space program. Dr. Seymour L. Wolfbein, deputy secretary of labor for employment and man power, said "any evening-out of economic opportunity is good." He said space installations would have an uplifting effect on their surroundings as the highly educated employes put down roots in underdeveloped areas of the U. S. He noted that the space program was different in this respect from public works projects such as highway construction, where the workers take temporary quarters and then move on.

Dr. Robert Solow, senior economist for President Kennedy's Council of Economic Advisers, agreed that the "evening-out" process occasioned by the space program is good as long as NASA does not engage in "hothousing"—putting installations where they are wanted but do not belong. NASA's emphasis on research, he said, may bring such

side benefits to the nation as inspiring more industries to increase their research. Also, he said the space program may provide jobs for workers displaced by automation and disarmament.

The evening-out process which Vice President Johnson wants and economists welcome is already under way and will be accelerated by space spending. Labor Department figures show that the western and southern rim of the country is expanding its industrial base much more quickly than is the rest of the United States. Between 1947 and 1960, the number of non-farm jobs rose by 22.5% for the U. S. as a whole. But non-farm employment in those years in eight states increased at more than twice that rate: Florida's increase was 95%; Texas, 47%; New Mexico, 95%; Arizona, 130%; California, 59%; Nevada, 92%; Utah, 48%, and Colorado, 44%. Louisiana's non-farm employment rose by 31% between 1947 and 1960, a growth rate which will increase markedly under the impact of the space facility at Michoud.

Great Lakes Area

In contrast to the tremendous industrial growth rate of the South and Southwest, the non-farm employment rate in the Great Lakes region—formerly the center of industrial growth—fell behind the national average. These were the growth rates between 1947-60 in that region; Ohio, 17%; Indiana, 15%; Michigan, 16%; Illinois, 9%; Wisconsin, 18%. A major reason for this comparatively slow rate of employment growth is automation in the auto industry.

Wolfbein said this evening-out of industry promises to change the classic migration pattern in the U. S. as displaced farm workers find they do not have to go outside the state to get non-farm jobs.

For example, the Michoud installation undoubtedly will provide jobs for many people who otherwise would have migrated to such cities as Washington or Detroit. As the trend continues, Wolfbein said "the movement from farm to city may be much more concentrated within a state than to locations outside a state."

Again, policy makers welcome this broadening of the industrial base and are taking definite steps to accelerate the trend. NASA Administrator James E. Webb said his agency is trying to get "vigorous competition" and more depth in the aerospace industry by spreading its contracts around. He said the decision by NASA to award the Saturn S-1 and S-1B contracts to different firms represented one implementation of this decision. How these two contracts plus the one for the Apollo spacecraft to take three men to the moon are awarded will be a dramatic test of NASA's "spread-the-work" policy.

As an example of its attempts to broaden the industrial base, NASA encouraged the auto industry to bid on the Saturn construction contracts. Ford Motor Co.'s Aeronutronic Division and the Chrysler Corp. have bid for the S-1 contract.

Webb, in explaining NASA's contract policy, said he wanted to avoid the shrinking effect from working with just a few companies. He noted the passage in the Brookings Institution report ("Proposed Studies on the Implications of Peaceful Space Activities for Human Affairs") which said one possible development is that "it will be the natural evolution of the space industry to thin down to a very few companies, each producing very few products for one major client—the U. S. government. The argument is based on the assumption that the government cannot afford to carry second and third best proposals to ensure the survival of also-rans for a day when they might have the best proposal.

"This support pattern, standard in the days of airframe competitions, can no longer be sustained because of the huge development costs."

NASA leaders realize that spreading contracts could aggravate an already painful quality problem in the aerospace industry. Dr. Robert C. Seamans, Jr., NASA associate administrator, told AVIATION WEEK: "In this country, many of our industries are geared to large production runs and have not perfected techniques for producing specialty items in limited volume. The space program demands precision equipment, usually in small quantity. Hence, quality control based on mass production methods does not provide equipment of sufficient reliability to meet our needs in space. We must increase the number of qualified technicians and craftsmen and improve their relationship to the designers and engineers in order to provide this capability."

In addition to getting better use of the industrial talent already available, the Kennedy Administration is trying to build a new relationship between the federal government and the educational institutions that train much of the manpower needed in the space effort. The Golovin Committee (AW Nov. 6, p. 26), in consultation with the Labor Department, looked into the long-range manpower needs of the space program in hopes of learning what technical backgrounds will be needed most. Their findings will be relayed to colleges and universities, but NASA has decided on a more direct approach to broaden educational interest and participation in the space program.

College Cooperation

Basically, NASA wants to get government and university scientists in the same disciplines to concentrate on the same space problems. In hopes of developing a format for closer government-university relationships, NASA leaders will meet soon with California college and university presidents to get their views on how to get fuller use from the Jet Propulsion Laboratory, which California Institute of Technology operates for NASA under contract.

These efforts to widen the political, industrial and educational base for the space program undoubtedly will help NASA get the money it needs for the space program. But an unknown—one which even space enthusiasts recognize—is how long multi-billion dollar-space expenditures can continue without exerting an inflationary force on the U.S. economy. Right now President Kennedy's Council of Economic Advisers sees space spending as helpful to the recovery effort. Solow said the space spending would be helpful to the general economy through this year and next. But after 1962, he said, such spending will have to be reappraised to determine if it might be inflationary. The council is conducting a special study now on the impact of space and defense spending on the national economy.

United Systems Center

Creation of a United Aircraft Corporate Systems Center at Windsor Locks, Conn., has been authorized by United Aircraft Corp.'s directors. The division, which will come into existence Nov. 16, will develop, manage and produce space, missile and other military systems.

One of the first contracts the division will seek is the USAF medium-range ballistic missile (AW Nov. 6, p. 23). UAC has spent several million dollars on development of propulsion and guidance components that would be applicable to an MRBM system.

Charles M. Kearns will be vice president for corporate systems and general manager of the center. He has been general manager of UAC's Hamilton Standard Division since 1958 and a vice president since 1960. The Missiles and Space Systems Department of Hamilton Standard will be merged into the systems center organization.

William E. Diefenderfer, assistant general manager of Hamilton Standard, will become general manager: Charles T. Roelke will serve as assistant general manager and Robert H. Shatz, technical director of the Missile and Space Systems Department, will be assistant general manager of the systems center. Hamilton Standard will continue to report to Kearns in his role as a vice president.

Bristol Partnership

Bristol Aircraft Corp., with Italian and possibly German industry partners, will enter a scaled-down version of its BAC 208 in the current North Atlantic Treaty Organization competition for a medium-range V/STOL transport.

Partnership agreement already has been made with Industriel Meccaniche Aeronautiche Meridionaci Aerfer, of Naples, for the joint submission of the proposal. Similar negotiations are under way in Germany with Dornier which has been working on an independent proposal.

Details of just how the production workload would be split in the event the aircraft should be selected by NATO have not yet been determined. The proposal will follow the general lines of the BAC 208 although it will be smaller in size. The 208, designed by BAC's Bristol Aircraft to meet Royal Air Force STOL requirement, would be powered by four Bristol Siddeley BS.53 lift-fan engines (AW June 26, p. 32).

Meanwhile, the deadlines for submission of proposals to NATO have slipped slightly for both the transport and the V/STOL strike reconnaissance fighter. Transport deadline has been extended from Nov. 15 to Nov. 22. For the strike reconnaissance fighter, the submission date has been stretched "about 10 days" beyond the earlier deadline of Dec. 31, a NATO spokesman said last week.

Soviets Have Exploded Total of 170 Megatons

Washington—Soviet Union as of late last week had exploded about 170 megatons of nuclear devices in the atmosphere, compared with a total of 125 megatons for the U.S. and Great Britain, and less than a megaton for France.

Revealing these figures at a press conference last week, President Kennedy emphasized that the conditions under which nuclear devices are exploded affect the amount of fallout, and that any comparison of tests must take into account that Russia has produced more fallout than the other nations combined.

U. S. scientists say that many of the recent Soviet tests were made under the worst possible weather conditions from the standpoint of spreading fallout (AW Nov. 6, p. 27).

Asked about concern in the U. S. over the arming of West Germany with nuclear weapons, the President said that Chancellor Konrad Adenauer has stated that Germany does not intend to arm with nuclear weapons. Mr. Kennedy said West Germany has almost no air force, a very limited navy and nine army divisions. East Germany, he said, has a substantially larger ground force with a smaller population. Any effort to suggest that Dr. Adenauer wants to remilitarize West Germany represents a "revengist attitude" and is wholly wrong, the President said.

By late last week, the number of Soviet tests announced by the Atomic Energy Commission since Sept. 1 totaled 31. Numbers 29 and 30, in the low to intermediate yield range, were exploded in the Novaya Zemlya area Nov. 2. Number 31, with a yield of several megatons, was fired in the same area Nov. 4, AEC said.

Bids Asked on Suits For Apollo Crewmen

Washington—Eight companies have been asked to submit proposals by Dec. 1 for the engineering design, development and construction of two types of full pressure suits for Apollo spacecraft crewmen.

Bids requested by National Aeronautics and Space Administration's Manned Spacecraft Center call for construction of four successively improved prototypes of advanced pressure suits, and two successively improved quick-assembly full pressure suits. Manned Spacecraft Center is the new name for the Space Task Group, now located at Langley Field, Va., which will be permanently located in Houston, Tex.

Companies asked to bid were Arrowhead Rubber Products, David Clark Co., B. F. Goodrich Co., International Latex Co., Mauch Laboratories, National Textile Research, Rand Development Corp. and Rubbex Fabricators.

News Digest

Accidental hydrogen explosion in the shed housing the Kiwi-B 1-A reactor at the Atomic Energy Commission Nevada test site may delay testing in nuclear rocket Project Rover. Extent of the delay is still being assessed. Cause of the explosion and the source of the hydrogen leakage were not known.

Rolls-Royce will start test-stand running of its RB.162 jet lift engine at a thrust rating of 4,400 lb. in next week or 10 days at Derby test facility.

Cole H. Morrow has been named director of Federal Aviation Agency's newly created airport service to administer federal aid to airports. The program authorizes $75 million a year for the next three years for improving the nation's airports. George R. Brosari, former chief of the now abolished Airports Division, will serve as Morrow's deputy.

Capsule from Air Force's Discoverer XXXIV which was successfully launched recently into polar orbit from Vandenberg AFB, could not be separated from the orbiting Agena B vehicle as a result of mechanism malfunction.

Edward H. Cockerham of Federal Aviation Agency's Air Traffic Service, field operations division, has been elected executive director of the Air Traffic Control Assn. Glenn Tigner, also of the air traffic service, replaces Cockerham as ATCA vice president.

National Airlines President G. T. Baker resigned abruptly as president in favor of Robert E. Wieland, his 42-year-old nephew, who succeeds him. Baker remains chairman of the board and chief executive officer.

North American X-15 set a new speed record of 4,070 mph. last week, exceeding its previous record of 3,920 mph. set Oct. 17. Piloted by Maj. Robert M. White, the plane attained the maximum speed of Mach 6.04 at 95,000 ft. Maximum altitude on the flight was 100,000 ft., top skin temperature was 1,100F. Outer portion of one windshield shattered during drop from the "mother" B-52.

First Indian-built Avro 740 turboprop transport made its maiden flight Nov. 1 at Kampur. Initial airplane was assembled from structural components, shipped from Great Britain, in jigs built by Indian technicians.

Nuclear-propelled submarine Ethan Allen, in six attempts, has successfully fired six Polaris ballistic missiles, five of which were the advanced A-2 1,500-naut.-mi. range version. The vessel will eventually be deployed with 16 A-2 missiles.

Another British Merger

London—Bristol Siddeley Engines, Ltd., last week bought two major British aeronautical engine companies, Blackburn Engines, Ltd., and de Havilland Engine Co., Ltd., for an undisclosed price.

The deal, made with Hawker Siddeley Group, puts Bristol Siddeley into a direct licensing and sales line with Turbomeca of France, through Blackburn, and General Electric through de Havilland. Existing agreements between the two firms were part of the sale, but probably will be renegotiated.

Bristol Siddeley is jointly owned by Bristol Aeroplane Co. and Hawker Siddeley. Sir Roy Dobson, Hawker Siddeley's vice chairman, said the move was made to bring aircraft engine design, development and manufacturing under single control.

Beacon Study Would Double Control Cost

Air traffic task force urges primary role for radar; implementation of plan would require $500 million.

Washington—New plan for utilization of the nation's airspace, expected to cost $500 million over the next five years, has been proposed by the Project Beacon task force on air traffic control. This is approximately twice as much as the Federal Aviation Agency has budgeted as a part of its Five Year Plan.

The long-awaited Beacon report, released this week, says the recommended program should be implemented within five years to meet the demands of a growing air traffic control system load that is expected to increase about 300% by 1975. The task force, headed by Richard R. Hough, estimated that a prototype air traffic control system of the type it proposed could be ready for initial tests within 18 months.

Major changes recommended by the task force include:

• **Radar should become** the primary means of traffic control, with radar scopes serving as the primary display for controllers and flight progress strips serving a secondary role. Nation-wide radar coverage would be obtained by combining existing Sage air defense radars and FAA en route and terminal area radars (AW Aug. 7, p. 41; Sept. 18, p. 38; Nov. 6, p. 29).

• **Extension of positive** control to all aircraft flying above 14,500 ft. (above 24,000 ft. near high mountainous areas) and to all aircraft above 8,000 ft. on high-density airways. To make these areas accessible to pilots without instrument ratings, the report would establish a third category—CVR—for Controlled Visual Rules. Thus positive control areas would not require instrument flight.

• **Segregation of controlled** and uncontrolled traffic on high-density airways and congested terminal areas, with speed limits on visual flight rules (VFR) traffic. In congested terminal areas, aircraft should be segregated according to performance and special arrival-departure ramps should be designated.

• **Radar beacon transponders** should be mandatory for all aircraft above 12,500 lb. gross weight and for all aircraft, regardless of weight, that land at controlled airports within designated congested terminal areas, when a low-cost, short-range beacon becomes available.

• **Automatic altitude reporting,** using radar transponder, to provide controllers with a badly needed third dimension and to minimize voice communications now required for such altitude reporting.

• **Automatic computers,** both for en route and terminal area portions of the airspace, to process flight plans, issue clearances, make conflict probes, generate display information, determine landing sequences and perform other routine tasks for the traffic controller. Many of these are functions which the data processing central (DPC), under development by the FAA for the past several years, was intended to provide. But the Beacon report recommends that general purpose digital computers be used, to reduce cost, instead of the special purpose ones developed earlier by General Precision, Inc. The report adds that much of the development work in the DPC project "will be directly applicable to the recommended system. In particular, work on radar displays and terminal area flow control and sequencing will be valuable."

• **FAA should undertake** a long-range program to develop an integrated all-weather approach, flare and landing system that also would enable takeoffs in near-zero ceiling and visibility conditions. The report suggests that this system incorporate a flare transition device to decrease glide angle during the final stage of an instrument approach and thus lower an aircraft's rate of sink just prior to touchdown.

Beacon Approval

Washington—President Kennedy last week asked Federal Aviation Agency Administrator N. E. Halaby to begin at once to carry out "those recommendations of the [Project Beacon] report which you believe will move the airways program forward rapidly and efficiently." The President said Halaby should design a system "to utilize those elements of the air defense system which you believe can be advantageously used in meeting air traffic control requirements."

• **New emphasis** should be placed on increasing the aircraft-handling capabilities of airports by improving ground equipment, segregating aircraft by type when possible and installing instrument approach aids at satellite airports to divert general aviation aircraft from major metropolitan terminals.

The Beacon report said that the current FAA research and development budget of $65 million per year should be adequate to cover work on the new system, but that "considerable realignment of current development programs will be necessary."

Air Defense Integration

One of the most controversial portions of the report is its recommendation against the adoption of Sage air defense computers for traffic control purposes on a joint-use basis. An inherent limitation on such joint use is the fact that Sage does not have the radar or computer capability to handle the terminal area portion of the traffic control problem.

The initial proposal considered by the Hough Committee was to use Sage computers to handle only the high-altitude portion of en route traffic control. This would have required FAA to provide its own computers for the remainder of the control situation at considerable investment and operating expense, and would have resulted in problems because of the division of traffic control between the two systems.

A later proposal considered was that Sage computers be modified so they could handle instrument flight rules (IFR) traffic at all altitudes and both IFR and VFR traffic above 14,500 ft. Under this plan, FAA would have to acquire its own computer facilities for terminal area operations.

If this plan were adopted, substantial modifications and additions would be required in the Sage computer centers, some Sage sector boundaries would have to be changed and numerous other changes made, the Beacon report says. Even then, the Sage system would not be able to handle peak air traffic load and air defense load simultaneously, the report concluded.

There are other operational disadvantages. The digital data processing applied to raw radar signals before they are introduced into Sage center computers reduces the ability of human controllers to track aircraft through storms and ground clutter. It also eliminates echoes of thunderstorm activity

from the controllers' scopes—information which is useful to controllers and pilots.

Instead, Project Beacon recommends that FAA use only the air defense radars of the Sage system and procure and operate its own en route and terminal area computer facilities. Estimated cost of this is only $100 million more in initial investment and $100 million more per year in operating and maintenance costs than the use of existing Sage facilities as proposed. Annual system operating cost is estimated at $255 million.

The Hough Committee concluded that this extra cost would be more than justified. It would leave the FAA's air traffic control system unaffected by possible changes in Sage air defense system that may be needed to accommodate new air defense concepts now under consideration, such as decentralized weapons control.

If the Defense Department should decide to abandon Sage at some future date in favor of decentralized weapons control, the FAA then would be forced to assume an additional $745 million in annual operating maintenance costs to keep Sage going for its traffic control purposes.

Datamation Suggestions

The report recommends use of computers and automatic data processing equipment to perform many of the services contemplated by FAA's present DPC development. However, the DPC's tabular bay console, in which flight progress strips were to serve as the primary controller reference with automatic updating of the strips by a printing head controlled by a computer, would be abandoned under the Beacon recommendations.

Instead, a small teletype printer near each controller position would periodically print out a full set of updated flight strips needed at that position. These would be inserted manually in holders and then used as replacements.

Contrary to views expressed at the recent meeting of the Air Traffic Control Assn., the Beacon report says that manual detection of possible flight plan conflicts relies too heavily upon the infallibility of the controller and becomes a more difficult task as traffic load increases.

It therefore recommends use of computers for conflict prediction.

The moderately high cost of computers, coupled with the need to provide sufficient standby capacity to assure continuous service, suggests that some savings in system cost could be made by reducing the present number of traffic control centers, the report said. But it notes that this saving might be partially offset by cost of additional facilities needed for transmitting radar data over greater distance. The report also suggests merging en route and terminal area control centers wherever practical.

Terminal Procedures

The report recognizes that major terminals such as New York, Los Angeles, Chicago and Washington "present the greatest hazards and create the most delays" for air traffic. Constantly climbing and descending VFR and IFR traffic plus large numbers of aircraft with widely varying performance characteristics are responsible, the report said.

To remedy this, the report recommends segregating inbound and outbound aircraft by establishing an "offairway structure of approach and departure corridors" leading upward to or downward from cruising altitudes. This structure must be capable of quick change to cope with local approach problems. It must not add to cockpit workloads by forcing pilots to use extra charts, follow complex clearances or change radio frequencies rapidly, and it must not discriminate against VFR or CVR pilots, the report said.

The corridor system would radiate from an airport at the center of a circle with a 50-mi. dia. (100 mi. at high altitude). Three approach corridors and three departure corridors would be available and variable according to at least two "predetermined plans" developed by local controllers. Aided by terminal VORs, controllers would vector traffic along these routes, with one controller assigned to each corridor. In good weather, if traffic warranted, an additional controller would direct VFR aircraft with low-performance capability.

The corridors would be shaped like consecutive sections of a pie. Working clockwise, the first corridor might be aligned with the airport's ILS localizer and assigned to airline jets descending for an approach. The second corridor would then be allocated to intermediate aircraft such as the Douglas DC-6 or Lockheed Electra. Second corridor inbound aircraft would be vectored to an ILS outer marker located about 4 mi. from the runway threshold, while low-altitude airway traffic would use the third corridor, relying on vectors to line up with the appropriate runway. VFR holding fixes in this corridor would eliminate random maneuvering close to the airport.

The report called the mixing of IFR traffic—which is afforded separation only from other IFR traffic—with VFR traffic, which is afforded no separation by traffic control, "particularly foolhardy." As a solution, the report said that pilots who fly only by ground reference should use services offered to IFR pilots by traffic control. To do so, they would file CVR clearances, maintain aircraft attitude visually and rely upon traffic control to furnish separation from all other traffic.

Helicopter Routes

Inauguration of IFR flying by helicopters, which FAA estimates will begin in early 1963, should be anticipated by the setting aside of special routes within terminal areas, the report said. Because these routes could fit into the 600 to 1,500 ft. altitude spectrum, they probably would not interfere seriously with other terminal area traffic.

By 1965-70, the report predicted, helicopters will be moving in and out of about 60 locations in the New York area alone. It is possible that 50 helicopters may be airborne at a given moment, all traveling within a narrow vertical band of airspace in which altitude separation is next to impossible. As a result, precise means of airway navigation must be developed by rotorcraft.

Project Beacon task force was composed of Hough, who is vice president of engineering for American Telephone & Telegraph Co.; USAF Col. Louis E. Andre, Jr., chief of the interceptor system staff office in the office of the deputy chief of staff for systems and logistics; Harry B. Combs, president of Combs Aircraft Co.; George C. Comstock, vice president and deputy technical director of Airborne Instruments Laboratory; James Digby, associate member of the research council of The Rand Corp.; William Littlewood, vice president for equipment research, American Airlines; Russell C. Newhouse, director of Bell Telephone Laboratories' Zeus Radar Laboratory, and Nathaniel Rochester, manager of advanced computer utilization in the data system division of International Business Machines Corp.

TWA 720B Failure

Lubrication failure in the No. 1 engine of a Trans World Airlines 720B last week led to turbine disk failure of the Pratt & Whitney JT3D turbofan engine. Metal thrown in the failure pierced the passenger cabin at the coat rack, causing loss of pressurization, and particles penetrated the wing with ensuing fuel leakage.

The incident, which occurred on a Los Angeles-Boston flight, took place at 25,000 ft. over the Albany, N.Y., omnirange station. An emergency descent was made, with loss of cabin pressure sufficient by 19,000 ft. to activate the passenger cabin oxygen mask system. None of the passengers was injured and the airplane landed without incident at Logan International Airport in Boston. Fragments of the nacelle later were found on the runway at the Albany airport.

Trunklines to Ask Fare Increase Regardless of Boyd's Opposition

Washington—Major trunklines, optimistic about their chances for higher fares, plan to file a series of new fare increase applications by the end of this month despite a denunciation of the idea by Civil Aeronautics Board Chairman Alan S. Boyd (AW Nov. 6, p. 37).

The carriers strategy calls for the filing of a variety of fare increases, expecting that the Board will approve an across-the-board increase to offset the industry's heavy losses from promotional and coach fares. As of late last week, United Air Lines and National Air Lines were the only carriers which had filed for increases.

Meanwhile, American Airlines asked CAB permission to abandon its controversial youth fare plan, transcontinental excursion fare and family fare plan by Dec. 15. In addition to American's request, a group of airline comments and statistics on promotional fares were submitted to the Board last week. A majority of the letters was reported to be highly critical of promotional fares and expressed a desire to drop several of them in the near future.

Promotional fares in general have failed to generate enough traffic to recoup the losses from a diversion of first-class fares, American said.

The airline emphasized that increased traffic volume also creates an increase in operational costs. It pointed out that while its total traffic volume is now 300% greater than it was 10 years ago, American now is in a far worse financial condition.

Diversionary losses on its transcontinental excursion fare alone, just for September, were estimated as high as $203,000, the airline said.

Eastern Air Lines said no discount fare on an established service has generated significant new business. The airline said it favored dropping the youth fare plan, family fare plan and the industry's 10% discount to servicemen traveling first class.

The airline emphasized that it considers its Air Bus and Air Shuttle as entirely new services which should not be regarded as promotional, since they have been diverting large amounts of highway traffic and creating new air traffic. Both operations have been "marginally profitable," the airline said.

Reduced rate and round-trip fares which the airline offers primarily from New York to Washington, San Antonio, Houston and New Orleans were adopted as a competitive measure and would be dropped if Eastern competitors would agree, the airline said.

Promotional fares should be employed to develop off-season traffic or to stimulate weekend travel in a manner that would prevent their use by business travelers who would fly in any event, the carrier said. The company is not sure it will offer its customary off-season fares to Florida next year, but is considering a new round-trip excursion fare for weekend travel.

Eastern also took issue with a Continental Air Lines plan to offer a "no frills" economy coach fare which would be approximately 25% below its present jet coach fares over a majority of the Continental route system. American and Trans World Airlines have also filed for this fare as a competitive measure.

Three classes of service on one aircraft would be too costly and would result in less revenue at a time when all carriers agreed they need more, Eastern said. The same idea was attempted by several North Atlantic carriers more than three years ago, but was abandoned as too costly and unprofitable, the airline said.

'Selective' Fare Changes?

Civil Aeronautics Board Chairman Alan S. Boyd's pronouncement on fares did not completely eliminate hope on the part of United Air Lines for adjustments, in the opinion of Andrew M. DeVoursney, executive vice president of the carrier.

"It certainly puts a damper on a general upward adjustment," DeVoursney said. "But is seems to have left some room for selective adjustments."

Intervention Expected In PAA-ALPA Fight

Washington—White House intervention was expected late last week to ward off a threatened strike by Pan American World Airways pilots before a midnight Nov. 10 deadline announced by the Air Line Pilots Assn.

Close similarity of the Pan American dispute with that of a Trans World Airlines pilots' dispute now being investigated by a presidential emergency board generated speculation that both problems might be investigated by the same board (AW Nov. 6, p. 38).

ALPA said the strike was called because of failure to reach agreement with the airline over wages and working conditions after 18 months of negotiation. ALPA said disagreements included Pan American's refusal to abide by the findings of a neutral fact finder, appointed by voluntary agreement between the union and the company.

Major area of disagreement, the union said, has been Pan American's failure to provide lower monthly flight time limitations, plus limitations on flight deck and total duty time during a 24-hr. period. While ALPA pilots on domestic operations are limited by contract to a monthly flight time of 85 hr., the union said, Pan American flight times on international routes are figured on a quarterly basis permitting a "lumping" of flight time in any month.

ALPA contends members have been forced to fly as much as 120 hr. a month because of this formula. It wants a specific monthly flight time limitation and a limit on pilot's flight duty deck time to 8 hr. in any 24-hr. period.

In other labor developments, the Flight Engineers International Assn., the National Mediation Board and representatives of seven airlines concluded a meeting called to discuss recommendations of the Feinsinger Commission.

The seven carriers were believed to have generally agreed to consider industry-wide bargaining to settle the current labor issues with the engineers' union.

Trans World Airlines navigators also were studying NMB recommendations involving objections of the Airline Navigators Assn. division of the Transport Workers Union to the use of dual doppler navigation equipment on TWA flights. ANA declined to comment on the NMB report, which recommended several severance pay formulas and job replacement recommendations that could be applied if the use of doppler should result in the displacement of navigators in the cockpit.

Northeast Merger

New York—Joint merger proposal by Eastern, National and Mohawk Airlines to Northeast was withdrawn "for the present" last week in a letter from the three carriers to David A. Stretch, chairman of Northeast.

The carriers said the merger discussions could not be resolved satisfactorily under existing circumstances. They said, however, that the move did not imply that a new offer would not be made.

Another avenue of possible merger for Northeast apparently was closed when TWA asked to withdraw as an active participant in the Florida route renewal case and advised the CAB that it does not plan to file a proposal to merge with Northeast.

Swissair Convair 990 Used in FAA Certification Program

Swissair Convair 990 takes off from Lindbergh Field in San Diego, Calif., on FAA certification test flight. The aircraft is being used to test the 990's communications and navigation equipment and autopilot. A second Swissair 990 will be used in the FAA functional and reliability program. The airline will receive its first 990 in November and will take delivery on all seven it has ordered by the end of February, 1962. Crew training will begin in December.

ALPA Elections May Shape Sayen's Role

Washington—Air Line Pilots Assn., its membership perplexed and divided by President Clarence N. Sayen's qualified "resignation," has scheduled two elections that promise to pit those who would retain Sayen in office against those seeking a new chief executive.

Outcome of these contests may prove decisive in determining how long Sayen serves as ALPA president. In a letter to union members (AW Nov. 6, p. 38), Sayen asked to be "relieved" of his duties not later than the fall of 1962. But if Sayen supporters should win the forthcoming elections, many pilots believe there is a strong possibility this date will be extended.

If anti-Sayen candidates are elected, his term of office may be cut short by ALPA's executive committee, which is known to have considered a formal resolution calling for Sayen's prompt resignation.

First Test

First ALPA officer to be elected will be a vice president to represent the union's third region. Nominations for this office are scheduled to close Nov. 15. Capt. A. B. Currie of United Air Lines, the incumbent, generally agrees with Sayen on ALPA issues and is expected to run again for the vice presidency. But re-election of Currie, while important to Sayen, probably will not alter the present balance of power on ALPA's executive committee.

The executive committee, composed of the union's eight top officers plus Sayen, is known to be split along these general lines:

• **For Sayen.** Capt. D. J. Smith of Trans World Airlines, treasurer; Capt. H. B. Anders of United Air Lines, region five vice president, and Capt. Currie.

• **Against Sayen.** Capt. John Carroll of TWA, first vice president; Capt. Paul Atkins of American Airlines, secretary; Capt. Al Clay of TWA, region one vice president, and Capt. A. D. Adams of Braniff, region four vice president.

Pivotal member of the group is the newly elected vice president of region two, W. T. Babbitt of Eastern Air Lines. According to ALPA officials, Babbitt's vote deadlocked the executive committee when it met on Nov. 1 to consider a resolution requesting Sayen's immediate resignation, and afforded Sayen an opportunity to break the tie. The day before this meeting, Sayen called a surprise press conference at which he announced his "desire to be relieved of the presidency."

The compromise plan that finally emerged from the Nov. 1 committee session shifted responsibility for accepting Sayen's "resignation" to the union's 300-man board of directors and scheduled a meeting of this group for May 29. The executive committee also decided that Sayen should be "retained as a consultant for a reasonable period, not less than three months, following the election of his successor" to ensure an orderly transition.

ALPA's constitution invests the executive committee with the power to call special meetings of the board of directors. The committee, through a vote of no confidence, also may request the resignation of any officer, but such requests are not enforceable. Whether the committee, as opposed to the board of directors, can accept the president's resignation is a point of contention within ALPA.

The political complexion of the union's executive committee also may be altered by the election of a vice president to represent ALPA's recently formed Steward and Stewardess Division. This officer, who is to sit on the executive committee, will be selected by the flight attendants' own board of directors after that body has been elected by local councils of the Steward and Stewardess Division.

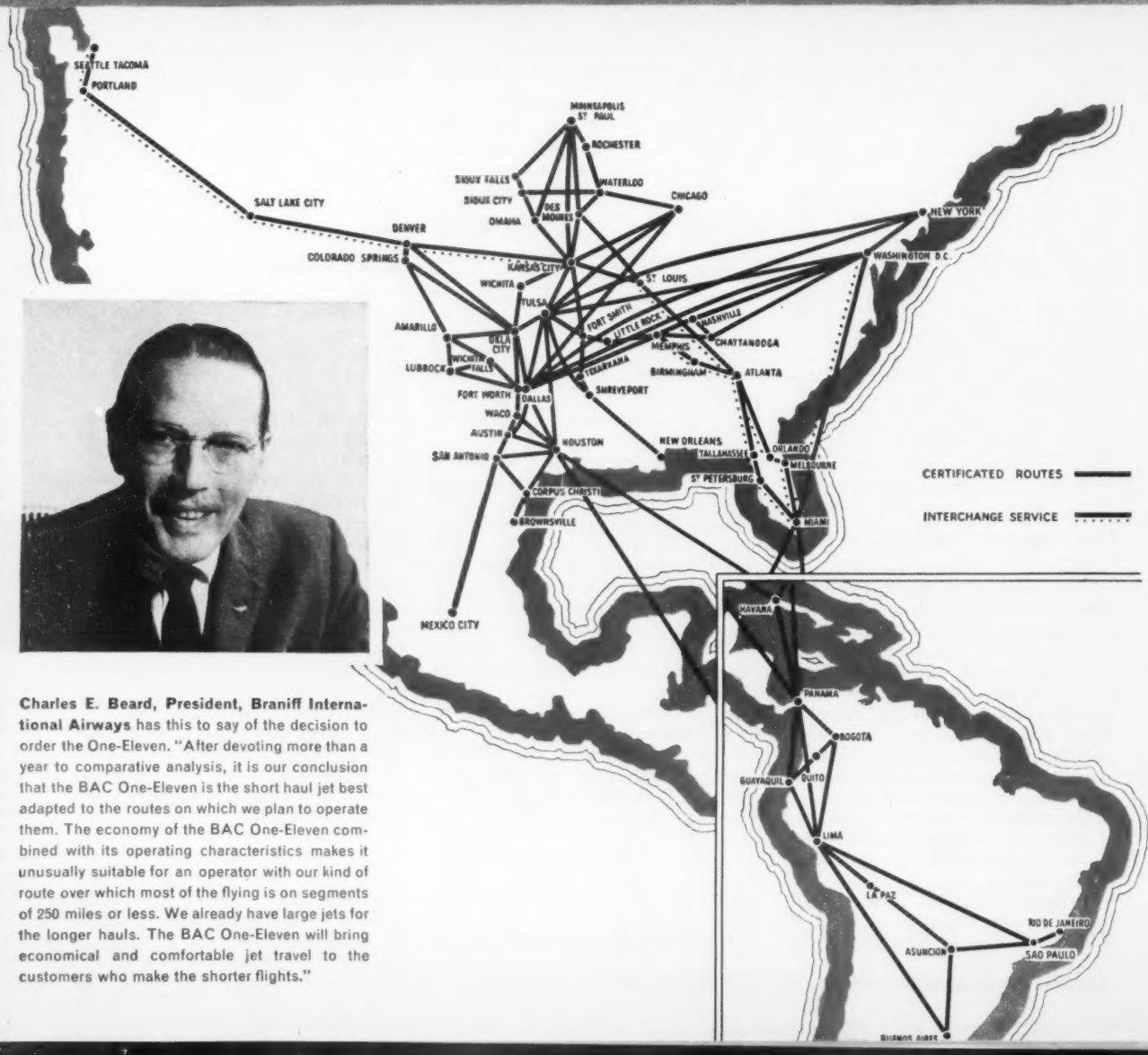
Flight Attendants' Support

Flight attendants affiliated with ALPA generally hold Sayen in high regard. For this reason, it is probable that their vice president will materially strengthen Sayen's position within the union.

Election of the Steward and Stewardess Division vice president probably will take place at the May board of directors meeting. But informed pilots believe that the balloting may be timed to precede debate on a successor to Sayen.

Speculation of other pilots who favor replacing Sayen centers on a chain of events that begins with the incumbent president's gaining control of the executive committee through the Steward and Stewardess election. The executive committee, as a result, would be unlikely to pass any resolution requesting Sayen's resignation. By persuasion based upon Sayen's accomplishments in office, his supporters might then convince directors representing a majority of the union's membership that Sayen's resignation request should be rejected. Such a vote could be interpreted as an expression of confidence in Sayen's administration and result in his agreeing to serve out a term of office that runs for three more years.

BRANIFF *International* AIRWAYS



Charles E. Beard, President, Braniff International Airways has this to say of the decision to order the One-Eleven. "After devoting more than a year to comparative analysis, it is our conclusion that the BAC One-Eleven is the short haul jet best adapted to the routes on which we plan to operate them. The economy of the BAC One-Eleven combined with its operating characteristics makes it unusually suitable for an operator with our kind of route over which most of the flying is on segments of 250 miles or less. We already have large jets for the longer hauls. The BAC One-Eleven will bring economical and comfortable jet travel to the customers who make the shorter flights."

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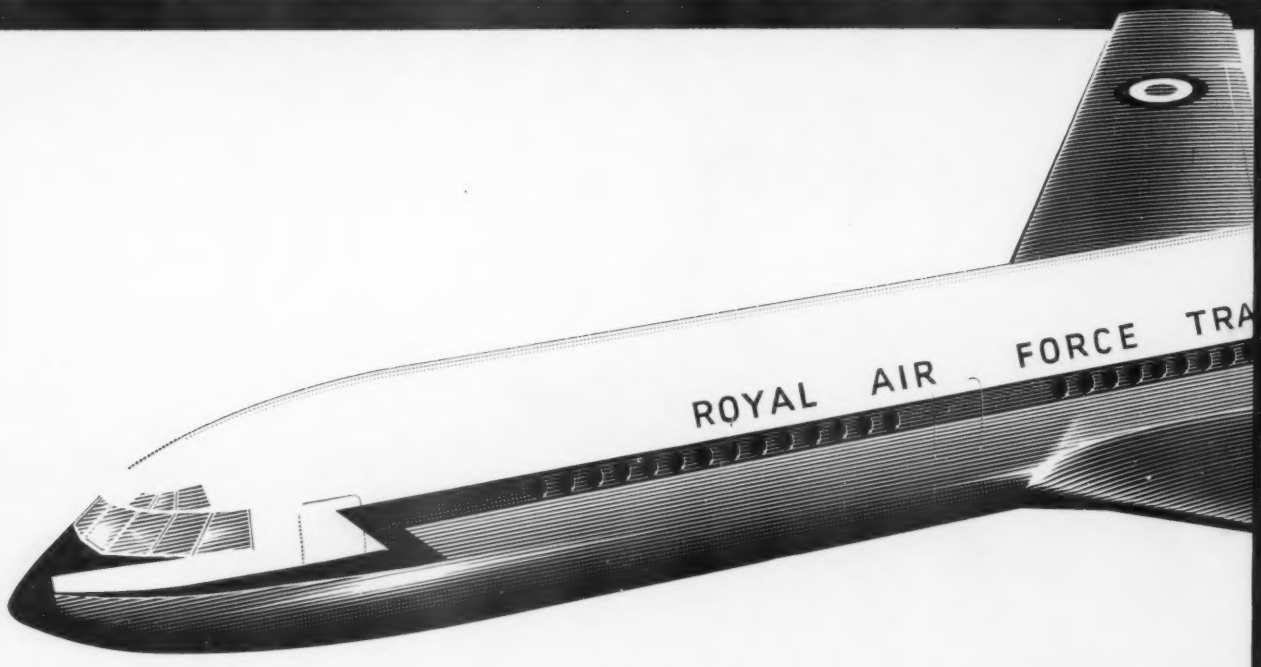

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Transatlantic Traffic Slump Continues

By Glenn Garrison

New York—North Atlantic airlines are moving into their winter off-season with little hope of a sharp increase in traffic to offset last summer's slump, which resulted in an increase of only 3% in scheduled passengers in the face of a 37% increase in capacity.

Last year at this time, when most of the carriers were operating large-scale jet fleets for the first off-season period, bookings were reported way up for the winter months, in some cases 50% and more (AW Nov. 7, 1960, p. 40). As it turned out, the North Atlantic airlines carried 35% more passengers in the final quarter of 1960 than in the previous like period. Capacity, however, rose 53% for the quarter.

An AVIATION WEEK survey of current bookings for the off season indicates a level generally only slightly higher than last year at this time. Capacity will be up again, but not as drastically as during the last off-season.

Bookings are less reliable than they used to be as an indicator of traffic because of the tendency to book later. Airlines report that the figures often change for the better a few days before a particular flight. However, little of the optimism evident last year—when the 17-day excursion fare was going in for the first time—seems reflected as this winter season goes into its second month.

The slump in traffic growth, critical when linked with the giant increase in seat capacity, began last May. For the four peak season months, June through September, the scheduled North Atlantic airlines carried 917,754 passengers, up from 884,152 in the summer of 1960. Capacity rose from 1,273,455 seats to 1,743,085, for a load factor in both directions of 53% for the 1961 period. This was a drop from a similar load factor in summer, 1960, of 68% in both directions.

First-class traffic was hardest hit, dropping 34% to a total of 95,225 passengers for the four months. Economy passengers totaled 822,529, a 9% increase.

For the nine months ending last September, scheduled traffic was up 8% to 1,484,674 passengers, and scheduled capacity was up 41% to 2,898,560 seats.

Charter Operations

Charter operations, which present some controversial aspects, zoomed during the summer period with an increase of 73% among the scheduled carriers to a total of 153,383 passengers. Some airline officials, proponents of lower scheduled fares, feel that the charter business is a way of begging the question and offering lower fares through the back door. Also, some question exists as to whether charters are accurately reported to International Air Transport Assn. In this view, an indeterminate number of charter passengers end up in the scheduled passenger totals.

Among the carriers reporting charters for June, July and August were British Overseas Airways Corp., with 202 eastbound legs; Lufthansa, with 72; KLM, with 74; Pan Am, with 163; SAS, with 32; and TWA, with 42.

Last summer's results, both in capacity offered and traffic carried, varied considerably among the individual carriers. Some examples:

• **Pan American** showed a 14% increase in passengers for the four months to a total of 191,071. Capacity rose 46%. Pan Am estimates its capacity for the winter season will be about 29% greater than last winter's. Bookings for the five weeks beginning Oct. 26 are 13% ahead of bookings for the same period last year.

• **TWA** traffic dropped 18% from the previous summer to a total of 101,605 passengers. Capacity was up 8.2% to 196,190 seats. Among the unfavorable factors cited by TWA are the increased transatlantic capacity of foreign carriers and their jet fleets; entrance of new carriers in the market, and competition from supplemental carriers operating charters under blanket exemptions. TWA's capacity this winter will be down slightly from last year: from about 3,200 weekly seats in each direction, beginning Nov. 1, to 3,100 seats. As of the same date, bookings for November were running about 7% higher eastbound and 5% lower westbound. TWA started promoting the off-season fare earlier this year than last.

• **BOAC** traffic also was down slightly, from 133,475 to 127,728 passengers. Capacity was up 23% for the four months. For the entire winter season, BOAC plans to offer about 85,061 eastbound seats, an increase of about 25%. A major unfavorable factor cited by BOAC is the fly-American directives of U. S. government departments. Also, BOAC was getting established in new U. S. points such as Washington-Baltimore. The British carrier expects to reduce its transatlantic capacity next summer by 7%, shifting Boeing 707-420 jet equipment to other routes.

• **KLM** increased its capacity by 16% to 129,106 seats. Traffic rose from 61,900 to 67,678 passengers. Capacity for the winter season will run about 2,542 seats a week, up from about 2,108 seats on the average last year. Bookings presently are about the same as last year, but KLM says it really is too early to estimate with any exactness.

• **Lufthansa** increased its traffic by 17% to 57,331 passengers and increased its capacity by 72% to 108,236 seats. Lufthansa feels an improvement in the market is absolutely dependent on an improvement in the political situation. The airline is particularly hard hit because the current political crisis is cen-

North Atlantic Passenger Traffic

June Through September, 1961

	Flights	Seats	Passengers	Load Factor
Air France	1,012	143,186	71,463	50%
Air-India	169	22,256	7,780	35
Alitalia	595	78,370	42,061	54
BOAC	1,964	249,958	127,728	51
Canadian Pacific	316	37,232	17,319	47
El Al	271	32,981	21,507	65
Iberia	127	14,374	4,856	34
Irish	325	40,015	25,774	64
KLM	1,129	129,106	67,678	52
Lufthansa	764	108,236	57,331	53
Pan Am	2,748	340,030	191,071	56
Qantas	69	6,382	2,945	46
Sabena	503	70,690	30,949	42
SAS	878	113,727	63,387	56
Swissair	529	67,824	32,816	48
Trans-Canada	730	92,528	51,484	56
TWA	1,433	196,190	101,605	52
Totals:	13,562	1,743,085	917,754	53

Note: Pakistan International Airlines began transatlantic service June 16. Figures are not yet available.

tered on the Berlin situation. Lufthansa, along with BOAC and other foreign flag carriers, cites the fly-American program as a particular source of traffic loss. The German airline's capacity this winter will be up about 41% over last winter's. Bookings are running about at last year's level.

• **Alitalia** carried 40% more passengers for a total of 42,016. Capacity increased 86.4% to 78,370 seats. This winter's capacity will be about 51% greater than last winter's. Bookings were up about 31% as of Nov. 3. Alitalia's big capacity boost of last summer coincided with the introduction of a full jet fleet; next summer's increase will be considerably less.

• **SAS** registered a 15% increase in traffic to 63,387 passengers. Capacity was up 9% to 113,727 seats. SAS plans to offer about the same capacity this winter as last. Bookings are reported as slightly up over this time last year.

• **Air France** increased its traffic from 59,272 to 71,463 passengers. Scheduled capacity rose about 49% to 143,186 seats. Bookings for the rest of 1961 and the beginning of 1962 are running about 10% ahead of last year's.

Controllers Question Future Value Of Various Air Traffic Measures

By David H. Hoffman

Miami—Air traffic controllers have begun to question whether there is a place in any future control system for computers that can only print flight progress strips, devices designed to predict conflict courses, and the present three-layer airway structure.

Criticism of these devices came during the Air Traffic Control Assn.'s annual meeting here when controllers assembled to discuss an ATC system soon to be reshaped by recommendations of the Project Beacon task force (see p. 34). But details of the Beacon report, then four months overdue, were not known to most controllers at the Oct. 30-Nov. 1 ATCA conference.

At an informal workshop on "automation evaluation," controllers made it clear that any plan to install additional "bookkeeping" computers similar to the Remington-Rand Univacs now in use at six Federal Aviation Agency Air Route Traffic Control Centers (ARTCCs) would not win solid controller support. Their objections:

• **Extra expense** of leasing additional computers to print, but not update, flight progress strips would divert funds from projects aimed at developing semi-automatic ATC systems with greater capability.

• **Expanded use** of flight progress strips is difficult to reconcile with the expanded use of radar in controlling air traffic. Satisfied with the results of radar to date, controllers want to focus their attention on radar scopes rather than on strips printed by a computer.

• **Problem of feeding** the computer with data, stuffing the flight progress strips into holders and distributing the holders to numerous center sectors, in some cases, requires more personnel than would be required to print and distribute the strips by hand.

With radar becoming the primary ATC tool in an increasing number of centers, controllers at the workshop recommended that FAA re-evaluate what constitutes a legal procedure within an ATC facility. They asked, for example, if it still served a useful purpose to require a written record of the control instructions issued to every flight. Would it be necessary to take motion pictures of each radar scope if radar resulted in the elimination of flight progress strips? And would not such requirements, if imposed, lessen the efficiency of the ATC facility?

Automatic conflict prediction—a system for warning a controller well in advance of any clearance that might steer an aircraft toward a collision—also was downgraded by controllers here. According to Horace Adams of FAA's ATC operations group at the Agency's Atlantic City, N. J., test center, the need for conflict detection devices decreases as radar control is substituted for manual control of air traffic. Visual presentations offered by radar, he said, make it relatively easy for a controller to predict en route conflicts without the aid of a sophisticated computer.

Automatic conflict prediction was to be the third function entrusted to the Data Processing Central semi-automatic traffic control system, which FAA once hoped would become operational in Boston during November, 1962. But FAA officials from the National Aviation Facilities Experimental Center said here that the prototype DPC system, according to present plans, will be retained at NAFEC and used to test new traffic control techniques and some components.

It would not, they said, be installed in an operational environment as a complete system. One of the six General Precision/Librascope computers purchased by FAA for use in DPC will be shipped to the Atlanta ARTCC sometime in Fiscal 1963 (AW Aug. 28, p. 52). There, at least initially, it will be used to print flight progress strips, according to Lyle H. Ditzler, acting chief of field operations analysis in the Agency's Air Traffic Service.

FAA now looks upon automation as an "assist to the controller," not as the "salvation for all our problems," Ditzler told the forum. The concept of DPC, Ditzler added, must be "changed considerably" because it is based on the "old system" of pilot position reports and estimated times of arrival over radio checkpoints.

Controllers and airline industry representatives here had little praise for FAA's three-layer airway structure, which went into operation on Apr. 6. According to these users, the intermediate altitude route system that extends from 14,500 to 24,000 ft. is a "stumbling block" for jets climbing to or descending from the high-altitude network above 24,000 ft.

Intermediate and high altitude airways often are not defined by the same VOR radials, controllers complained. Pilots added that their transitions through the intermediate airway structure involve cluttering the cockpit with unnecessary charts. As more high-speed jets are scheduled over short-range route segments, this problem is aggravated because pilots have only two choices: climb to altitude and then descend shortly thereafter, or remain at low altitude where fuel consumption is high and slower piston-powered transports present a traffic control problem.

Computer Use

According to Capt. J. D. Smith, director of air traffic control for United Air Lines, United is using a computer to evaluate just how high its jets should fly on short-range route segments. In this evaluation, fuel consumption is being balanced against time to climb and descend, he said.

Controllers here also expressed concern that the qualifications demanded of would-be controllers may be relaxed in the future to attract sufficient new personnel. On this point, Jacob Meisel, chief of personnel programs division, said that the backlog of qualified candidates already on the civil service rolls was adequate to keep controller strength at authorized levels for the next three to four years.

FAA is tackling the problem of controller stress, anxiety and fatigue in two ways, reported Dr. David Trites of FAA's Civil Aeromedical Research Institute. He said the Agency was redoubling its testing efforts to ensure that only controllers able to withstand "stress-causing conditions" are hired in the first place. In addition, FAA is studying controller fatigue in an effort to pinpoint and eliminate the causes. Dr. Trites made it clear, however, that FAA's present emphasis is on the screening method.

Local Service Carrier Expansion Criticized

By William H. Gregory

Hartford, Conn.—Growing intensity of the drive by local service carriers for wider markets was a controversial issue at an aviation symposium here sponsored by the Connecticut General Life Insurance Co.

Civil Aeronautics Board Chairman Alan S. Boyd, who made a major policy speech which dealt with fares and mergers (AW Nov. 6, p. 37), also commented on the local service issue—not in his speech, but in response to questions later.

"If the trunklines were making the kind of money they were in 1955," he said, "the Board might look with sympathy on the local service plea. But I, for one, would not want to put the trunks in a bucket by expanding the subsidized local carriers."

With the drive by local service carriers has come also a tendency to alter terminology. The local service carriers now are sometimes being called regional carriers and a new class of carriers is being postulated and referred to as third-level carriers. These would be a new type of airline, probably operating light twin-engine aircraft, and would take over low-density points that cannot be served economically by local service Douglas DC-3, Convair, Martin or Fairchild F-27 equipment.

As a sidelight, Eastern Air Lines' vice president-engineering, Charles Froesch, used the term regional carrier to describe local service airlines in a discussion of a short-range jet transport (AW Nov. 6, p. 41). He included Eastern in the analysis because, "leaving out a few of its longer flight segments, the rest of its route map shows it to be a large regional air carrier."

Local Service Issue

The local service issue was never completely joined because the principal critic, Donald W. Nyrop, president of Northwest Airlines, was unable to appear on his scheduled panel. However, his statement was circulated at the meeting and was known to other participants.

In it, Nyrop was critical of the Board's approval of the Capital-United merger, contending it had nullified all the progress the Board had made in recent years in strengthening the seven medium-size trunk carriers, including the southern transcontinental awards. Lack of relatively equal economic opportunity for the seven middle carriers as against the trunks, Nyrop said, has serious implications for their economic survival.

"More recently, however," he said, "they have likewise found themselves subjected to attack from beneath—the additional threat of diversion of their revenues to the subsidized local carrier. They are indeed in danger of being caught between the upper millstone of the four major trunklines and the nether millstone of the local service carriers."

Nyrop noted the claims of rapid growth of the local carriers, but he also pointed to increases in subsidy.

"These figures underscore," he said, "what local service carriers seek to ignore—that the growth in the volume of traffic carried by them is, in material part, the product of adding more and more route miles and points served, routes which are quite evidently less economic to serve. The obvious consequence is a subsidy bill which is achieving heroic proportions.

"A second factor contributing importantly to the size of the subsidy bill undoubtedly is the provision of excessive service by the local service carriers in many markets."

Short-Haul Aircraft

Local service carriers are already studying short-haul, pure-jet aircraft, and to support such aircraft are seeking unrestricted access to relatively short haul but high density markets now served by the trunklines, Nyrop said.

"Such an evolution, if not accompanied by a continuation of subsidy," he said, "can only result in another group of medium-sized trunkline carriers with the same problems which now so urgently require attention in the case of the existing trunkline carriers."

Despite all talk of creation of a third layer of carriers, such a situation already exists in the gradation of Big Four trunklines, the seven medium-size trunks and the local service carriers, Nyrop asserted. And despite all the talk of merger as the only effective remedy for the ills of the airlines, Nyrop contended:

"More thoughtful evaluation will reveal that a series of mergers, drastically reducing the already depleted ranks of medium-sized carriers and concentrating the airline industry in the hands of a few giants, would be neither a cure-all nor in the national interest."

The spokesman for the local service carriers, Robert E. Peach, president of Mohawk Airlines, did not explicitly reply to Nyrop but he noted:

• **Earnings** of the local service segment of the industry have been abysmal, nonexistent. "I don't believe," he said, "that we can continue on this basis if we are to have free-enterprise short-haul carriers."

• **Regulation by definition** has arbitrarily split the airline industry into trunk and local carriers, though the problems each faces are common to both.

• **Subsidy** is not determined by the arlines or even CAB, but by Congress as a benefit to the local community. "It's not up to us to defend subsidy," Peach said. "It's up to us to reduce it—or provide the best level of service possible for the subsidy allocated."

Better ATC Needed

Emphasizing that "Mohawk wants to get off the dole," Peach pointed to improvements in traffic control as one possibility for a solution. At present, Mohawk's 100-200-mi. commuter-length trips leaving the New York area, for example, are subject to the same delays as a transcontinental jet flight.

"If we could get some form of ATC," Peach said, "in which the extent of delays would be proportional to the length of trip, Mohawk could reduce direct operating expense 33%. Total subsidy need would disappear. There could be a profit, and possibly even a reduction in fares."

This type of problem Peach cited as one affecting both trunk and local carriers. "It's about time," he said, "that CAB and the Air Transport Assn. reach the conclusion this is all one industry."

Peach's thesis that all airlines were one industry did not win agreement from Boyd. He told questioners that he felt the local service airlines represented a completely different situation than the trunks.

Nor did the move by the local carriers to enter more profitable markets gain much encouragement from other panelists. Commented William B. Harding of Smith, Barney & Co., a New York investment banking firm:

"I am optimistic that the local service carriers, without competition and with a higher rate structure than the trunks, can get on a self-supporting basis [without subsidy], provided, however, they don't get too fancy ideas.

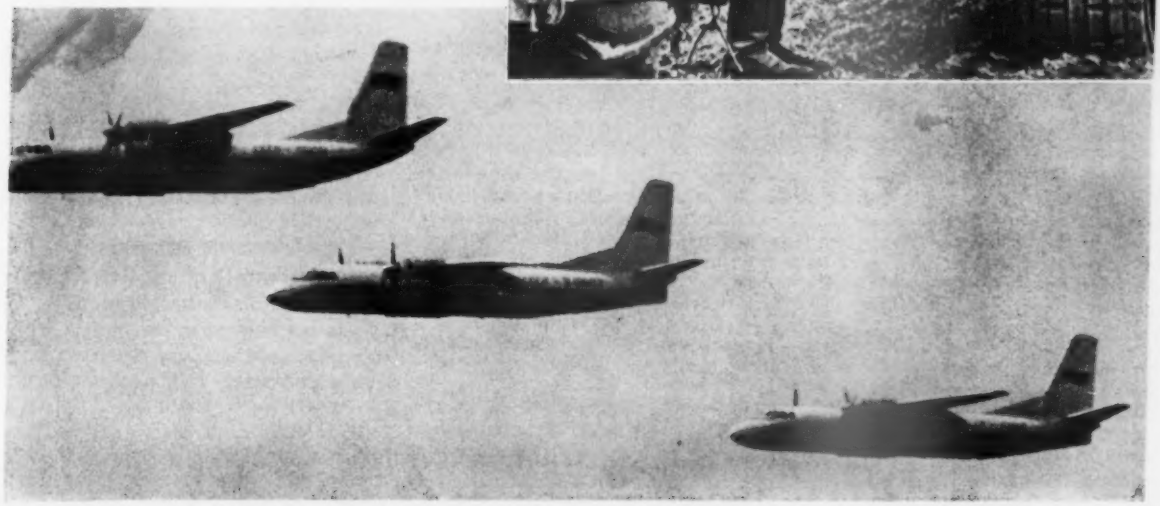
"Some of them already are beginning to cry that, in order to maintain and expand their profit margins, they must be allowed to compete in high-density traffic markets. If this is permitted, the basic problem of excessive competition will never be solved.

"There are plenty of markets that are rich enough to earn profits for quite a number of carriers, but the profitability of a single route should not determine how many carriers should be allowed to fly over it. The over-all profitability of each system should be the determining factor."

Landing gear of An-14 "Pchelka" (Bee) light transport mounts large, low-pressure tires for operations from rough fields (right). Tractor and driver probably have been superimposed on picture; note how driver appears to be standing on mud that will not support other man. In above photo, prototype Pchelka transport banks away from camera plane.

Soviet An-14, An-24 Transports Designed For Rough Runways

Three An-24 twin-turboprop transports in Aeroflot markings show minor aerodynamic difference and change from prototype, unveiled 18 months ago (AW June 13, 1960, p. 39). Additional ventral fin area, corresponding to earlier similar addition on An-10, shows on two of the planes. An-24 is a feederliner in the F-27 Fokker Friendship class for operation from sod and dirt runways. Plane will carry 32-40 passengers.



Off The Drawing Board And....Into The Air

From the time that the new YS-11 was first placed on the drawing board, it was decided that emphasis would be placed upon several important features which were missing in similar type airliners. Best economy for short haul operations, with greater payloads and shorter take-off requirements, are combined with the highest standards of safety and performance under all climatic conditions. Added to these, the excellence of the new Rolls-Royce Dart R.Da-10/1 turboprop engines insures top performance. The new YS-11 is now ready to prove all of these points in operation. The prototype is scheduled to fly early next year and production models will be placed on domestic service lines in Japan during the summer of 1963.
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Super Broussard May Serve Fiji's Needs

By L. L. Doty

Suva, Fiji—Early need for a turboprop transport aircraft capable of operating into rough fields under tropical conditions has led Fiji Airways into serious consideration of the French-built Super Broussard.

Although no firm decision has been made on a new aircraft to supplement Fiji's fleet of three de Havilland Herons, two Drovers and one Beaver, opinion now is that the Super Broussard (AW June 5, p. 40) is the only aircraft available with the performance characteristics Fiji needs for its passenger and mail services.

Final decision rests with the technical development section of Qantas Empire Airways, which is joint owner of Fiji with British Overseas Airways and TEAL of New Zealand and which, under the agreement, is operational supervisor of Fiji.

In its evaluation of Fiji's fleet requirements, the Qantas technical group has eliminated the French-built Potez 840 turboprop transport as too small. The de Havilland 125 executive-type transport now in production, powered by two aft-mounted turbojet engines, has been all but dropped from consideration for the same reason.

Ingestion Problem

Several airlines have been approached by de Havilland with a design proposal of a larger version of the 125, the 126, but the British manufacturer is apparently still undecided as to whether it will move ahead with the project. This aircraft, with a 20-24 passenger payload and a takeoff weight of 23,600 lb. would be ideally suited to the needs of Fiji. However, the airline is shying away from the turbojet-powered transport because of a concern over possible debris ingestion by turbojet engines which are operating from grass or coral-rock fields.

The Fokker Friendship turboprop is considered too large for Fiji because of its low aircraft utilization due to low-density traffic, purely daytime operations and lack of navigational aids in the areas it serves. Other short-haul aircraft, such as the Convair 340 or the Martin 404, are also oversized for Fiji's operation.

The Douglas DC-3 fits size requirements but it is not being considered because of the need for modernizing the Fiji fleet with turbine engine aircraft.

Thus, the Super Broussard appears to be the answer to Fiji's requirements. The aircraft, powered by two Bastan IV turboprop engines each with 986 eshp. at takeoff, has a passenger cabin with a usable volume of 1,293 cu. ft. Cruising speed with maximum continuous power is 210 kt. Takeoff ground run is 985 ft.; landing runway distance without an obstacle is 720 ft. Maximum range is 858 naut. mi.

Unique Operation

While Fiji's operations are unique in contrast to most short-haul or local service airlines in other parts of the world, it is one of a growing number of feeder airline services being developed to provide connecting services from established airports to out-of-the-way locations which lack the facilities of a modern runway.

Fiji's three 15-passenger de Havilland Herons are the backbone of its operations. It conducts two daily round-trip services between Suva, capital of the Fiji Islands and one of the largest seaports in this part of the Pacific, and Nandi, location of the major airport servicing transpacific jet flights as a refueling and maintenance point.

Nandi, with its 10,000-ft. runway, is fully equipped with navigation aids, including ILS, VOR and radar terminal control. It is the only airport on the Fiji system so equipped. Fiji has not installed airborne equipment compatible to these facilities since it cannot be used elsewhere.

Suva airport has a macadam-surfaced runway but its only navigation aid is a nondirectional beacon. All other airports served by Fiji are equipped with similar beacons, but runways are mere grass strips maintained locally.

All flights within the island group are flown by dead-reckoning, and despite consistently poor weather in the mountainous area between Suva and Nandi, the airline maintains a high standard of operating efficiency.

In-Flight Failures

In-flight engine failures have been at a minimum.

Fiji serves three communities in the outer islands with the Herons on a regular schedule. Two villages, Ura and Matei, which are without landing strips, are served by the Beaver which has been equipped with pontoons for amphibious operations. During the month of August, Fiji carried 1,469 passengers between Suva and Nandi and a total of 3,000 passengers system-wide.

In addition to the intra-island service, Fiji is entering into a regional-type operation in the South Pacific area, adding emphasis to the need for new equipment. Regular service is now operated weekly between Fiji and Tonga, some 405 naut. mi. from Suva. A similar service to Faleolo in Western Samoa is being started this month, to give that area its first scheduled air service.

Fiji plans to begin, probably before the end of the year, a service to Honiara in Guadalcanal. Charter service to this area has been operated since 1960. Eventually, the airline would like to expand its service into Tarawa which would give it a completely integrated network of air services in this southwest Pacific region. With the amount of traffic predicted in this region, a 20 to 24 passenger aircraft would suit the operation.

Range is an essential factor since no airport served on the over-water regional operations is back-stopped by an alternate airport. All available landing strips are grass without lights of any type and only non-directional beacons as navigation aids. No point served by Fiji beyond Nandi and Suva is equipped with refueling facilities.

For regional operations, Fiji cuts the seat total from 15 to 11 to provide for a galley and lavatory aft and a navigator's position forward. Only navigational equipment carried on the Herons in addition to standard flight instruments are two ADFs, a Hughes 1A periscopic sextant, Dakota drift indicator, and navigational charts. As one Fiji operations official put it, "what else is there we can use?"

Qantas Manager

Chris Richtie is manager of Fiji Airways and directs all its operations. Richtie, a Qantas official on assignment to Fiji, has been able to build Fiji into a successful operation during the past two years with no interference from its airline owners.

For all practical purposes, Fiji is a separate entity.

Fiji Airways was founded in 1952 by Harold Gatty, who inaugurated service with two de Havilland Dragon Rapide biplanes. Just before his death, Gatty added the two de Havilland three-engine Drovers which Fiji still operates in charter service.

In March, 1958, Qantas purchased Fiji Airways from the Gatty estate. Because of political and strategic interest in the area, by Britain and New Zealand, Qantas invited BOAC and TEAL to participate in the operation. On Jan. 1, 1960, a joint agreement was signed whereby each carrier held a one-third ownership in Fiji with Qantas assuming the responsibility for the management of the company.

With 70 employes—a large number of them native Fijians, Fiji Airways handles all its own maintenance and major airframe and engine overhaul.

LINE-UP of L 200A Morava aircraft at Prague-Ruzyne Airport. The four-to-five seat Moravas form the backbone of CSA's rapidly growing air taxi services. Recently, 10 were added to CSA's air taxi fleet to replace some of the carrier's aging three-to-four seat Aero 45s.

Czech Airline to Expand Air Taxi Service

Prague—CSA Czechoslovak Airlines hopes to extend its growing nonscheduled air taxi operations beyond its national borders within the near future.

While working on implementation of this expansion of its taxi service beyond Czechoslovakia for the first time, CSA reports that this division has grown steadily since its inception in June, 1951. Growth figures for the air taxi service—the first of any importance within Europe, according to CSA—include:

- **Total miles flown** in 1951, 295,879, had increased to 1,132,218 mi. for 1960. Total mileage for the first eight months of this year, 854,484.
- **Number of hours flown** in 1951, 2,372; 1960, 8,039; first eight months of this year, 5,626.
- **Number of passengers carried** in 1951, 5,802; 1960, 18,153; first eight months of this year, 13,078.
- **Total passenger ton miles flown** in 1951, 60,531; 1960, 362,453; first eight months of this year, 288,503.

At the present rate of increase, CSA expects operational results to reach an all-time high by the end of the year.

In step with traffic growth, CSA is increasing and modernizing its fleet of light aircraft for air taxi duty. Early this year, the airline took delivery of 10 four- to five-seat L 200A Moravas, an improved version in the L 200 Morava series of which CSA already operates three in addition to 13 three- to four-seat Aero 45s.

To demonstrate the Morava's medium-range capability on the occasion of the tenth anniversary of the company's air taxi operations, an aircraft of the L 200A series this summer made a nonstop cross-Channel flight from Prague to England. A spokesman for the carrier said the aircraft made the return flight from Gatwick Airport, South England, to Prague in 4 hr. 37 min. On landing at Prague, it had an hour's reserve fuel.

Fuel Capacity

Total fuel capacity of the L 200A Morava is 110 U.S. gal. The aircraft is powered by two six-cylinder Czech Walter Minor M 337 engines developing an output of 210 hp. and fitted with direct fuel injection and compressor. Cruising speed is approximately 175 mph., range 1,060 mi. The L 200A is capable of taking off or landing on very short airstrips or unprepared ground.

Center of CSA's air taxi services is Prague-Ruzyne Airport, home base of all CSA operations. In addition, of a total of about 100 domestic airports including unprepared grass strips, the company maintains about 18 subsidiary air taxi centers at strategic points throughout the country. Altogether these serve 70 towns and smaller places, most of them on a year-round basis, although most of the smallest with no runways or ground facilities have to be closed to air traffic during the winter months because of adverse weather.

CSA to Add Tu-104A to Fleet

Prague—CSA Czechoslovak Airlines expects to add another Russian-built Tu-104A 70-passenger twin-jet transport to its present fleet of four by the end of the year. The additional Tu-104A will be used to step up the frequencies of the carrier's international jet services.

These include four round-trip flights a week between Prague and Moscow, three between Prague and Paris and two a week to London. The fourth, and latest, Tu-104A flight, introduced early last year on a once-a-week round-trip basis to Rangoon and Djakarta via Cairo and Bombay (AW Oct. 17, 1960, p. 49), now calls at Dhahran, Saudi Arabia, where CSA was granted commercial landing rights in August this year. Previously, the Czech carrier operated the Prague to Djakarta route via Bahrein where it maintains only technical facilities, but no traffic rights.

CSA also hopes to open a new service from Prague to Havana in the near future (AW June 5, p. 52), but details as to the kind of aircraft to be used, frequency of operation or whether the company expects eventually to obtain landing rights at Lisbon or the Azores are still being negotiated.

Between June and September this year, CSA for the first time operated Tu-104A jet and Il-18 turboprop charter services to Constanta, Rumania, and Varna, Bulgaria, catering primarily to the growing number of Czech tourists to and from the seaside resorts in the Black Sea area during the peak summer months. These extra flights were operated on an average of twice a day both ways.

CSA's four Tu-104As are being converted from their original 70-passenger capacity to an 80-passenger configuration. Cabin interiors also are being redecorated and CSA says that the new color scheme in pastel shades in addition to greatly improved design and quality of the seats should increase passenger comfort considerably. The conversion and redecoration of one Tu-104A is already completed; the remaining three will have to undergo the same improvements by the end of the year.

Study Finds Convenience of Auto Lures Many From Airline Travel

Washington—Preference of many travelers for the auto may force airlines into entirely new marketing concepts as the industry fights this increasing threat to its growth potential (AW May 1, p. 38).

Analysis of a recent marketing survey conducted in Florida revealed that 72% of motorists interviewed preferred auto transportation because of over-all convenience, even though a majority had flown before, according to the Air Transport Assn., which made the survey in cooperation with the Florida Development Commission last July and August.

Air travelers, who comprised 252 of the 713 persons interviewed, indicated their major reasons for choosing air transportation, beyond the speed advantage, was its comfort and relaxation.

ATA does not consider the results conclusive enough to warrant an immediate change in marketing concepts, but feels additional surveys should be conducted first in other areas of high population growth, such as Arizona and California.

Misunderstand Cost

ATA points out that this survey also disclosed that 57% of the auto travel group overestimated what their trips would have cost if taken on an airline. Of the remainder, 20% estimated too low, and 23% were about right.

This could indicate the need for a full-scale advertising campaign to clarify the cost of airline travel and place more emphasis on its comfort and relaxation, ATA feels.

ATA said the survey revealed these other statistics which should be studied further to determine their significance:

- **66% of the auto users** had taken an air trip, and 65% indicated they favored air travel in general.
- **40% of the motorists** considered air travel safer than auto travel, and 48% believed air transportation is as safe as car travel. Only 5% of the air travelers admitted any fear of flying.
- **62% of the motorists** drove from 500 to 1,000 miles to reach Florida; 18% exceeded 1,000 miles and the balance up to 500 miles.
- **30% of the auto users** traveled alone or with only one other person and the remainder in groups of three or more. In comparison, 82% of the airline travelers arrived alone or with one other person.
- **37% of the motorists** had annual incomes of $10,000 or more, as compared with 56% of the air travelers.

The survey also noted that 84% of the auto travelers were on vacation as compared with only 52% of those flying. 15% of the auto group were on business, or combined business and pleasure trips, as compared with 33% of the airline users.

Auto Advantage Cited

Of those who preferred auto travel because of convenience, 20% emphasized sightseeing advantages and 18% cited the desirability of having a car available at their destination. Only 16% of the total motorists interviewed said they chose the auto because of economy.

Among airline users, 17% criticized the noise and vibration of aircraft, 14% complained about flight delays and terminal waits.

However, 39% estimated that it would have cost them much less, or slightly less, to make their trips by car, but chose to use air transportation instead.

The ATA analysis noted that auto travel into the Florida market area has increased 3% during the year, while air, train and bus carriage has fallen about 1%.

ATA said that airlines have little chance of increasing their share of this market unless "drastic changes" can be made in travelers' knowledge and attitudes about air travel.

CAB Rules Frontier May Drop Routing

Washington—Frontier Airlines, operating under injunction by the Nebraska state courts on its segment 13 between Omaha and Casper, Wyo., has been authorized to drop service to all points on the routing after Dec. 19.

The Civil Aeronautics Board began the service investigation in August, 1960 and authorized Frontier to suspend service on segment 13 until 90 days after the final decision on the case. In the meantime, the Nebraska Department of Aeronautics was granted an injunction by state courts making Frontier serve the route.

CAB ruled that the experimental nature of the route was proved by the fact that for the year ending June 30, 1960, only 6,600 passengers had been generated instead of an anticipated 34,000—at subsidy cost variously estimated by Bureau Counsel at $64 per passenger and Frontier at $55 per passenger. Board's original estimate was $9 per passenger.

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► International Brotherhood of Teamsters organizers are concentrating major efforts on Trans World Airlines cargo and stores department employes, with emphasis on the airline's Chicago operations. Success at TWA would put the Hoffa-led union into four airlines. Teamsters have gained a foothold at Pan American World Airways, where the union represents 800 stock clerks, at Western Air Lines, with 600 mechanics and the Flying Tiger Line, with 91 stewardesses.

► **Need for early planning to create airline route structures capable of supporting supersonic transport operations is a key consideration behind Civil Aeronautics Board Chairman Alan S. Boyd's statement urging mergers of carriers and the desirability of only two carriers per route (AW Nov. 6, p. 37). Another reason is that CAB believes this situation would make it much easier to fix responsibility for adequacy of service in cases of complaints from communities.**

► Transports operated by trunklines employing block overhaul systems have better-kept interiors than the same type of aircraft operated by carriers using continuous maintenance systems, local service purchasers of used equipment are concluding. The block system entails idling an aircraft as long as necessary to accomplish overhaul.

► **Federal Aviation Agency's "civil" jet advisory service is being broadened to include Military Air Transport Service jets operating along the high altitude airway network in continental U. S. The service warns jet pilots flying above 24,000 ft. of conflicting traffic.**

► Rolls Royce predicts that steadily climbing times between overhaul (TBO) of major airline turbojets ultimately will result in the airlines' subcontracting almost all engine overhaul to independent specialists. If labor is to be utilized economically, an airline shop must overhaul at least six engines a week, the British manufacturer believes. But to gain this rate of flow on a 3,000-hr. TBO engine with 85% average achieved life, an airline must operate about 80 four-turbojet aircraft before it can justify an overhaul facility.

► **Studies ordered by Federal Aviation Agency show that positive control of air traffic moving through a given area imposes significantly increased workloads on controllers. A study revealed that controllers using traditional techniques at Oakland, Calif., expended about seven-tenths the effort to move a similar traffic volume as controllers using positive control techniques in the Indianapolis Center. Study was conducted by Courtney and Co.**

► Joint United Air Lines-RCA evaluation of airborne radar as a proximity warning device has come to a halt after extensive low-altitude testing in a United Convair. RCA and United determined that the problems of ground clutter and inadequate side lobe suppression produced spurious targets on the airborne scope. United recently dropped a plan to install the modified radar equipment on a jet to learn whether target indications are true above 15,000 ft.

► **Swissair is planning a series of new route extensions to Afghanistan and the Sudan, under recent agreements signed with these countries by the Swiss government.**

► Sikorsky S-61L twin-turbine helicopter was certificated for airline use by the Federal Aviation Agency last week. Los Angeles Airways and Chicago Helicopter Airways have each ordered four of the new aircraft.

► **Field fix will be available for an inlet casing cracking problem in the Pratt & Whitney JT3D turbofan engine. It consists of strengthening attachment points between the inlet vanes and the shroud. Another problem with the engine–fuel manifold cracking–also has been fixed. Engines in production now have all manifold joints brazed with a nickel gold alloy. Engines in service are modified by means of welded sleeves over the manifolds.**

SHORTLINES

► **American and Eastern** airlines' proposed $152 joint coach fare between Miami and San Francisco via Chicago –equivalent to fares between the same points on the more direct southern transcontinental route–has been suspended by Civil Aeronautics Board until January 30, 1962, while it investigates whether the reduction is warranted in view of the increased distance. Joint first-class fares over the same route were also suspended.

► **Central Airlines** in contrast to the trunklines, reports it has been "delighted" with the response to its youth fare plan after its first month in effect. The carrier says 840 young people took advantage of the fares to account for 3.8% of the total boardings for the month.

► **Delta Air Lines** reports a net income of $353,711 for the third quarter of 1961. Figure includes $265,000 from the sale of equipment. Last year's income for the same period was $351,611 which included $262,088 on the sale of equipment. Total operating revenue for this year's third quarter was over $36 million–a 16% increase over the same period last year.

► **Federal Aviation Agency** has approved an aerodynamic change to the leading edge of DC-8 jet transport wings which gives a range increase and higher speed. Change, involving sharpening the leading edge of the wing and increasing the chord 4%, has been approved for DC-8s already delivered as well as those scheduled for delivery.

► **KLM Royal Dutch Airline** will cut its interest rates on its "travel now pay later" plan from 6% per year to 4½%. Plan is to become effective 30 days after KLM files with Civil Aeronautics Board.

► **Lake Central Airlines** reports it carried 37,978 passengers during September, an 82% increase over the same month last year. Much of the increase was due to additional routes serving the West Virginia area, Washington, D. C. and Baltimore, granted since last December.

► **Trans World Airlines** has asked Civil Aeronautics Board to approve a fare plan that would allow military personnel in groups of 50 or more to fly home at Christmas for less than half the regular round-trip fare. Sample reductions: Paris to New York, $210 round trip instead of $525; Frankfurt-New York, $225 instead of $561. Fares would be in effect from Dec. 1 to Jan. 31.

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Airline Income and Expenses—August, 1961

(IN DOLLARS)

	Passenger Revenue	U.S. Mail	Express	Freight	Charter	Total Operating Revenues	Total Operating Expense	Net Income Before Taxes
DOMESTIC TRUNKS								
American	33,571,206	690,884	390,376	2,366,067	.....	37,400,793	35,825,934	1,574,859
Braniff	6,046,070	169,215	71,340	250,598	123,417	6,769,799	6,199,360	427,981
Continental	5,215,000	101,000	43,000	147,000	16,000	5,620,000	5,112,000	273,000
Delta	11,419,000	234,000	140,000	442,000	.....	12,414,000	11,956,000	272,000
Eastern	19,762,395	464,881	.....	1,007,330[1]	.....	21,384,873	23,478,138	-2,299,474
National	6,309,001	166,081	33,013	300,195	80,046	7,048,027	6,915,758	11,451
Northeast *	4,280,000	.....	.....	.....	.....	4,559,000	4,960,000	- 400,000
Northwest	7,438,922	198,552	.....	490,606[1]	39,179	8,212,741	6,998,136	1,043,386
Trans World	24,993,928	499,578	.....	1,544,921[1]	130,392	27,475,142	26,490,141	- 279,231
United	42,094,121	1,463,254	.....	2,939,712[1]	170,177	46,965,611	45,434,695	1,335,934
Western	6,098,211	114,168	.....	159,518[1]	105,045	6,500,963	5,721,711	601,618
INTERNATIONAL								
American	543,829	6,879	332	60,760	.....	647,818	597,067	50,751
Braniff	864,815	33,615	.....	72,499	.....	1,018,230	1,070,249	- 74,735
Caribbean Atlantic	338,631	3,305	.....	19,155[1]	2,428	368,488	305,464	63,023
Delta	162,000	.....	.....	4,000	.....	174,000	222,000	- 52,000
Eastern	2,871,011	51,167	.....	141,977[1]	.....	3,064,945	2,478,845	544,421
Mackey	161,202	.....	508	3,606	.....	178,534	170,872	6,292
Northwest	2,627,561	703,540	.....	335,317[1]	188,810	4,019,942	2,832,008	1,145,937
Pan American Combined	36,598,000	2,670,000	.....	4,343,000	3,441,000	48,667,000	40,456,000	8,711,000
Alaska	608,000	21,000	.....	70,000	.....	699,000	598,000	162,000
Atlantic	17,880,000	1,264,000	.....	1,896,000	2,047,000	23,728,000	20,327,000	4,480,000
Latin America	9,002,000	222,000	.....	1,226,000	108,000	11,181,000	9,716,000	1,601,000
Pacific	9,108,000	1,163,000	.....	1,151,000	1,286,000	13,046,000	9,827,000	3,576,000
Panagra	1,394,000	60,000	.....	224,000	28,000	1,982,000	1,822,000	123,000
South Pacific	52,252	291	.....	11,248[1]	.....	63,946	111,149	- 59,525
Trans World	7,603,323	665,910	.....	742,515[1]	372,849	9,573,952	8,059,400	752,353
United	3,293,730	115,804	.....	86,629[1]	.....	3,523,187	2,427,332	1,045,109
Western	561,832	4,525	.....	12,677[1]	.....	580,861	369,369	201,766
LOCAL SERVICE								
Allegheny	1,274,227	24,120	23,999	42,898	.....	1,934,933	1,772,202	102,333[2]
Bonanza	473,794	4,004	1,548	8,488	1,583	791,074	715,603	58,259
Central	360,215	14,195	5,374	16,218	991	777,971	720,540	54,239
Frontier	690,316	15,854	7,354	31,430	9,941	1,377,193	1,239,730	53,310[2]
Lake Central	534,249	12,091	13,345	12,041	1,950	943,021	891,270	30,606[2]
Mohawk	1,078,124	15,123	15,380	21,166	50,810	1,683,354	1,539,372	51,295[2]
North Central	1,588,321	38,319	29,800	45,581	.....	2,420,145	2,132,005	270,121
Ozark	691,235	16,626	18,425	29,450	4,770	1,130,639	1,040,847	77,919
Pacific	616,563	13,457	8,944	10,319	4,019	1,017,133	861,556	122,342
Piedmont	806,028	12,682	10,271	16,388	.....	1,284,259	1,128,846	133,170
Southern	523,495	18,101	9,677	20,542	3,178	951,691	844,352	94,294
Trans-Texas	484,259	12,958	6,431	25,078	5,005	912,987	849,492	56,766
West Coast	600,411	10,619	3,770	15,867	8,689	1,068,025	923,673	135,321
HAWAIIAN LINES								
Aloha	621,353	2,076	.....	5,657	.....	649,609	493,522	128,527[2]
Hawaiian	913,163	3,458	.....	84,962	.....	1,020,568	760,584	224,794[2]
CARGO LINES								
Flying Tiger	.....	4,693	.....	870,250[1]	2,156,826	3,052,792	2,911,071	- 26,707
Seaboard World	.....	364,614	.....	458,245	1,500,643[3]	2,341,180	2,611,576	- 335,519
Slick	.....	.....	.....	.....	1,193,541	1,202,174	1,062,306	109,911[2]
HELICOPTER LINES								
Chicago Helicopter	136,689	135,898	.....	.....	.....	272,565	262,724	10,049
Los Angeles Airways	29,455	11,991	15,078[4]	.....	.....	149,951	142,425	8,488
New York Airways	101,732	4,003	1,700	2,802	.....	314,417	331,360	- 16,730
ALASKA LINES								
Alaska Airlines	265,577	51,528	870	54,161	105,795	704,113	728,414	- 2,262
Alaska Coastal	143,820	10,300	.....	13,341	7,376	228,824	201,629	25,011[2]
Cordova	32,239	10,855	.....	17,110	37,024	125,504	122,881	1,572
Kodiak	39,244	935	.....	2,702	20,843	66,325	40,111	27,278[2]
Northern Consolidated	171,239	72,889	.....	56,684	.....	406,442	336,079	25,861[2]
Pacific Northern	1,050,023	91,151	2,835	133,431	468	1,407,850	1,082,590	322,740
Reeve Aleutian	205,551	49,542	.....	47,894[4]	41,776	349,482	204,566	144,460
Western Alaska	12,321	6,469	.....	976[4]	11,474	31,589	22,865	4,613
Wein Alaska	252,728	77,836	.....	53,349	110,741	642,948	517,495	125,452

* Northeast's figures are estimates.

1 Property (includes freight, excess baggage and express).

2 Net profit or loss 3 Passenger and freight. 4 Includes excess baggage.

Figures for Trans Caribbean, Riddle, Ellis and Avalon were not available.

Compiled by **AVIATION WEEK** from airline reports to the Civil Aeronautics Board.

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TURBINE-POWERED TRAINER used by Swiss air force is the DH-115 Vampire-trainer. All turbine-powered aircraft currently in service with the Swiss air force are of British manufacture, but French-designed Mirage IIIC is on order.

Swiss Air Force—Part I

Swiss Air Force Problems Many, Varied

By Cecil Brownlow

Berne—Swiss air force, beset by financial crimps, political restrictions, a dominant army and major reliance upon "weekend-warrior" reserve pilots, is struggling to maintain a combat force capable of protecting its nation's borders in an age of mounting crisis and advancing technology.

For anyone accustomed to almost any other accepted air force structure, the problems of the Schweizerische Flugwaffe and the means it must use to try and meet them are unique.

The constitution of this traditionally neutral nation prohibits a standing armed force of consequence during peacetime, or the presence of any one commanding general, for that matter, since his strength might present a possible threat to the elected government.

The air force's funds for training—enough for each pilot to fire 12 folding fin rockets per year—and for modernization are severely limited and controlled for the most part by the army. Its mission also is determined by the army—close support first and foremost, battlefield air superiority next if there are planes to spare.

"The Swiss," one experienced observer says, "simply don't recognize what air warfare is in its over-all aspects. They have never had to fight a war where it was used."

The small, professional core of the Swiss air force recognizes the need, however, and its attempts to find aircraft that can adequately carry out the army's close-support demands as well as provide some intercept capability combine to make most of the decisions on equipment orders a compromise at best. Another compromising factor is the knowledge that the aircraft will be placed largely in the hands of reserve pilots, who will each have only 70 to 80 hr. of flying time per year to maintain proficiency and combat capability.

The Dassault Mirage IIIC, latest and initial all-weather aircraft to be ordered by the air force, was not the first on the performance list of a number of planes evaluated over a two-year period, including the Grumman F-11F-1F, the Lockheed F-104 and Sweden's Saab Draken. It can be used, however, for close support and intercept—as others could—has a respectable range and, importantly, "it is a very easy plane to fly," according to air force officials. "This," they add, "was one of the major considerations."

One other aircraft among those tested "was better from the pilot's point of view, but its price was too high and its acceleration at altitude too slow."

Meeting Mirage financing is a major problem in itself in that the annual Swiss defense budget is laid out as a package, with no specific amounts earmarked for the exclusive use of the air force, artillery, etc.

The army also is modernizing and, under the present structure, its needs come first. Therefore, the appearance of the first Mirages will be delayed until the 1963-64 period, with lack of funds the main deterrent, although planned licensed production of the airframe and engine in Switzerland also contributes to the delay to a lesser extent. Delivery of the last of the 100 aircraft now on order is scheduled to take place in 1967.

Under current air force procurement practices, which stipulate that aircraft should have a 10-yr. combat service life, this means that the Mach 2 Mirage must maintain an operational capability until well into the mid-1970s.

For the moment, the air force, with about 500 jet aircraft in varying degrees of obsolescence that could be thrown into the breach if time and circumstance permit, gains its major strength from Switzerland's traditional ally, the fortress Alpine ranges, whose rock wall faces provide the basic element for the nuclear-resistant underground hangar areas used by the combat planes and whose valleys serve as landing strips for pilots trained to make sharp-turn, mountain-skipping takeoffs while pulling g forces of six and sometimes higher.

Current equipment consists of 100 Hawker Hunters on the front line di-

vided into five squadrons, 250 de Havilland Venoms and 150 Vampires, both of which are rapidly approaching their 10 years of service life with the Swiss, divided into units of 11 and 5 squadrons respectively.

Primary role of the Hunter is that of interception, while the older Venoms and Vampires concentrate on close support duty but also are expected to show an air-to-air capability. The Hunters, in turn, must be capable of shouldering the close-support burden when necessary.

Security Jeopardized

Although Swiss national policy is one of neutrality, Swiss officials are under no illusions that a Soviet attack from the east, conventional or nuclear, will fail to place its security in serious jeopardy or that a modern air force is not a necessity rather than a costly prestige item as some of its critics contend. Helpful as they are, the Alps alone are no longer an over-riding deterrent even in conventional warfare, although here they still represent a formidable obstacle.

One potential attractive feature for the Soviets would be use of Swiss airfields for any sustained strike aimed toward southwestern France or Spain.

A look at a map of Western Europe shows there are relatively few places where they could place their planes for strikes at these areas. Switzerland is one.

This, again, is where the Alps can help, with their man-made subterranean tunnels that protect the air force's combat aircraft. One officer explains:

"We don't care about fallout when we're under rock. We can even take off and land under these conditions since the exposure time after leaving or before entering the rock would be very short.

". . . To get us, he [the enemy] would have to use ground bursts and, when he did this, both Swiss industry and the airfields would be lost to him. Not much would be left."

Lack of similar protection for its anti-aircraft units, including the recently ordered Bristol Mark II Bloodhound from Britain, is a matter of prime concern.

"You can't bury them, or else they are of no use, and the Bloodhound's mobility is limited. The antenna unit alone weighs about 40 tons . . . This is why we think an air defense with fighters is much more adaptable to this type of warfare."

Delivery of the Bloodhound will mark the air force's initial appearance into the missile arena. Their aircraft are still dependent upon fixed gun installations and trays of folding fin rockets for aerial warfare.

A number of U. S. and British air-to-air missile systems have been evaluated, however, and a final decision as to the type, or types, to order should be forthcoming within the next few weeks. U. S. entries include infrared and radar-guided versions of the Hughes Falcon, recently evaluated by a Swiss mission at Hughes, and an adaptation of the Douglas Genie whose normal nuclear warhead would not be available to the Swiss under present American restrictions.

DH-112 VENOM is used primarily for close support of Swiss army units, but is also expected to have air-to-air capability.

Here again, the cost consciousness of the purse string-controlling army, of which the air force is a semi-autonomous division, can play a final role in the decision.

The air force says it needs both radar and infrared versions to be prepared to fight in any type of weather or atmospheric conditions. The army, aware of the fact that the British rely primarily upon infrared guidance for their air-to-air missiles, insists that infrared alone is sufficient, that a complementary radar system is too easily jammed.

"Certainly radar can be jammed," an air force official says, "but infrared also can be re-directed by artificial heat sources, etc. With the weather we have in Central Europe, we need both types."

Initial Mobilization

Equipment aside, first and foremost task of the air force, and of the army, in the event of any surprise attack would be the initial mobilization.

Drafted in the days when war was a slower moving thing, and still valid if sufficient political warning is received, the mobilization of the armed forces can be remarkably rapid once set into motion. The problems of today are twofold—without mobilization, there is substantially no armed force in being, as decreed by the Swiss constitution; two, it must be ordered and in being by 6 p. m. on the day before the air and ground units are needed for actual defense.

If ordered before 6 p. m., the national railway can divert its traffic and schedules for the transport of troops to their proper destinations, the reservists can report to pre-ordained posts on time for the morrow, in position and ready for action—whether in an underground hangar or a mountain outpost hanging from an Alpine crag.

If ordered after 6 p. m., end of the normal working day in Switzerland, chances are slight that the force will be ready to fight on the following day. The political warning, to be effective, must come on time.

Reaction Time

"Time has caught up with the system," one officer concedes. "We think it's sufficient [time] to counter a ground move. But, for an air move, our reaction time is too slow."

Another problem is that before mobilization, a preponderant amount of the armed forces' supplies, ammunition, spares, etc., are located in central, well-known depots. "You can pick up a telephone book and find out where all our depots are," one air force spokesman says. "The real danger for Switzerland is to be hit before we are mobilized."

Mobilization can be ordered—as it was during World War II—as a precautionary move in times of danger. Under its neutrality system, however, the mere presence of masses of troops on its border or even temporary violations of territory by aircraft or ground troops in sizable numbers are not regarded as sufficient reason for Switzerland to declare war, although the incursions would be monitored and possibly resisted.

A declaration of war would only be

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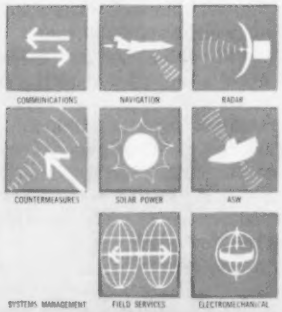

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SIGNIFICANT DEVELOPMENTS AT HOFFMAN HAVE CREATED POSITIONS FOR SCIENTISTS AND ENGINEERS OF HIGH CALIBER. PLEASE ADDRESS INQUIRIES TO VICE PRESIDENT, INDUSTRIAL RELATIONS

DH-100 VAMPIRE, used primarily for army close support by the Swiss air force, is rapidly nearing the end of its programed 10-year service combat life. Replacement will be the Dassault Mirage IIIC.

made when it is evident that a "major hostile act" has been directed against Switzerland as such. Then, and only then, would the Parliament elect a single commander for the armed forces from among the senior officers. "Today," one official says, "the war could be over by the time we elected our general."

Day-to-day ruling body of the armed forces is the National Council of Defense headed by the civilian minister of defense and composed of the six lieutenant generals of the army plus the commander of the air force, Maj. Gen. (Colonel Divisionnaire) Etienne Primault.

Lonesome Agent

Until recently, Gen. Primault had no vote on the council and attended its sessions in an advisory capacity only, making known the air force views when they were requested. Award of the vote, however, is of relatively little importance since he is the lone air force voice.

As head of the air force, Gen. Primault is in charge of four separate commands, each under a brigadier general—the "air force" (flying units), "airports" (all ground units, including maintenance, supply, logistics, etc.), the anti-aircraft command, which will man the Bloodhounds, and the "Air Warning Regiment" (radars, ground observer corps and communications).

Within these spheres, Gen. Primault has a certain freedom of action, but over-all control and planning remains tightly in army hands. The army chief of the general staff, Lt. Gen. J. Anasohn, is responsible for all war planning, including materiel selection and procurement. All air force purchases must be approved by him, and he and his staff are the only ones with authority to place such proposals before the Defense Council and Parliament. There was no air force officer on his staff until recently. Now there is one.

Since there is no "standing" military force under the constitution, Gen Primault is considered to be on active duty when in uniform, a civilian when in mufti. But, in uniform or out, command of the air force is his full-time job. His planning and headquarters' staff at the "Swiss Pentagon" here work under essentially the same criteria—a full-time job with the officers on "civilian" status except for their active duty periods.

There are personnel, however, on year-round active duty under a clause in the constitution which permits this for "instructors." These largely represent the air force's immediate reaction group which, it is hoped, would hold the line in any surprise attack until the mobilization had completed its cycle and the reservists were in place to join the fray.

Professional Units

Of the 21 squadrons, four are "professional" units that are constantly manned by career officers and air crews and kept in readiness to meet any manned attack from the air or ground. There also are approximately 25 career instructors who train the air and ground students and have combat assignments in fighter aircraft as well. These officers, moving from base to base and carrying their respective student groups through the full spectrum, from primary through advanced jet training, have control of all facets of training under Gen. Primault and normally manage to spend only about two months a year at their home base in Dubendorf.

The problem of providing continuous maintenance programs for the aircraft and weapons in a force centered around reservists is simply solved. The maintenance crews work as civilians except for their three weeks of active reserve duty each year when they don their uniforms and continue their regular chores.

Their record is an excellent one, and the confidence of the pilots in their work is unexcelled. A career colonel, with thousands of flying hours, says:

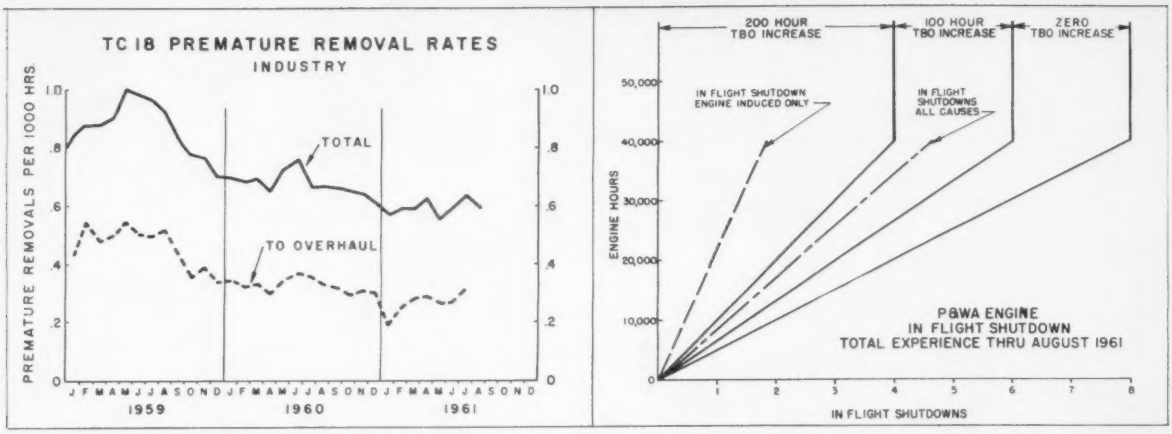
"We very, very seldom have technical problems. I think our mechanics are the best in the world. A big checklist like you have in the States doesn't exist. We don't need it. I've been flying now for 27 years, and I've only had one forced landing—during the war in a trainer when we were flying too much.

"And, as long as the Swiss air force has existed [since 1914], there has never been an instance where a parachute failed to open.

"I give the maintenance people my airplane, tell them what's wrong, and, what they do, I couldn't care less. I've been in England and the U.S., and they do a good job, but I've never seen work like we get. They are the watchmakers. Perhaps the Swiss people are like that. They are interested in every detail."

The accident record bears the colonel out—an average of two fatalities a year in an air force largely manned by reservists who are called upon to fly over, and very near, some of the world's most rugged terrain in weather conditions that can change by the minute.

(This is the first of two articles on the Swiss Air Force. The second will detail the training methods of the civilian cadets who return home after each course is completed and the means employed to maintain the proficiency of the reserve pilots.)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PREMATURE removal of Curtiss-Wright Turbo Compound engines is detailed at left; Pratt & Whitney experience is charted at right.

Airlines Refine Maintenance Management

By David H. Hoffman

Miami—U. S. airlines currently are concentrating their technical attention on sophisticated management techniques in an effort to reduce the $500 million they spend each year on maintaining and overhauling aircraft.

After solving most of the nuts and bolts problems that cropped up during the transition to jets, trunkline engineers are taking a fresh look at the business tools developed by more mature industries—electronic data processing, maintenance analysis and quality and cost control systems.

But at the annual Air Transport Assn. Engineering & Maintenance Conference, it was apparent that the airline industry is nowhere near agreement on how these techniques should best be exploited. Without hesitation in the past, the carriers have pooled their technical resources to speed de-bugging programs and devise equipment fixes.

However, this unified approach to problem-solving is far more difficult to apply in the management area because of widely varying route structures, fleet sizes, capital bases and seasonal traffic patterns, engineers here tacitly agreed. In a two-day exchange of technical reports—many of them accompanied by stacks of computer input cards and readout forms, airline organization charts and internal planning and auditing documents—they demonstrated that the goal of cost-cutting through standardization was a distant, if not unrealistic, objective.

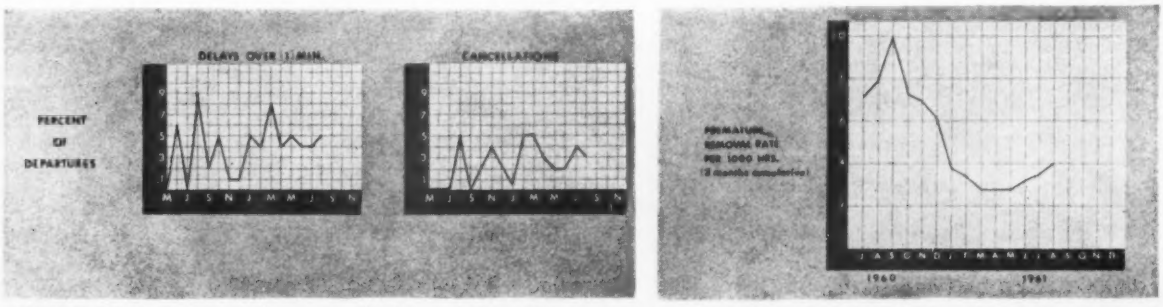
There was not, for example, a single sign at the ATA forum that indicated the domestic carriers were moving toward joint purchasing of spare components, sharing of ground support equipment at major terminals or merging maintenance and overhaul functions in general. ATA's maintenance analysis subcommittee did develop a 50-page code identifying thousands of aircraft parts numerically by system and location that could form the basis of a common data collection and computer analysis system at some future date. But the subcommittee also recommended that it be disbanded until "further need for its service arises," making this prospect appear dim.

These key points detailing the status of maintenance and overhaul within the industry emerged from the comments and formal reports of ranking airline engineers here:

• **Scientific control systems** can have a great effect on the over-all cost of maintaining and overhauling aircraft. Continental, for example, installed such a system 18 months ago for less than $10,000. Since then, the total direct cost of its engineering and maintenance division has dropped 9.6% despite the fact that total work force increased 38% and contract wages climbed 6%.

• **Airlines' headlong rush** to entrust more and more engineering and maintenance functions to computers may be producing harmful side effects. Some airlines have found that administrative payroll savings are canceled by the hiring of the new personnel needed to feed the computer increasing quantities of data. At the same time, collection of this data often hampers mechanics at work and lowers labor productivity in the shops.

• **Jet fleet expansion** is forcing even the larger trunklines to reassess the advan-



CONVAIR 880 jet transport departure reliability as influenced by its engines compares favorably with all other civil jet transports and is significantly better than most piston planes (left). Convair 880 premature engine removal rate is at right.

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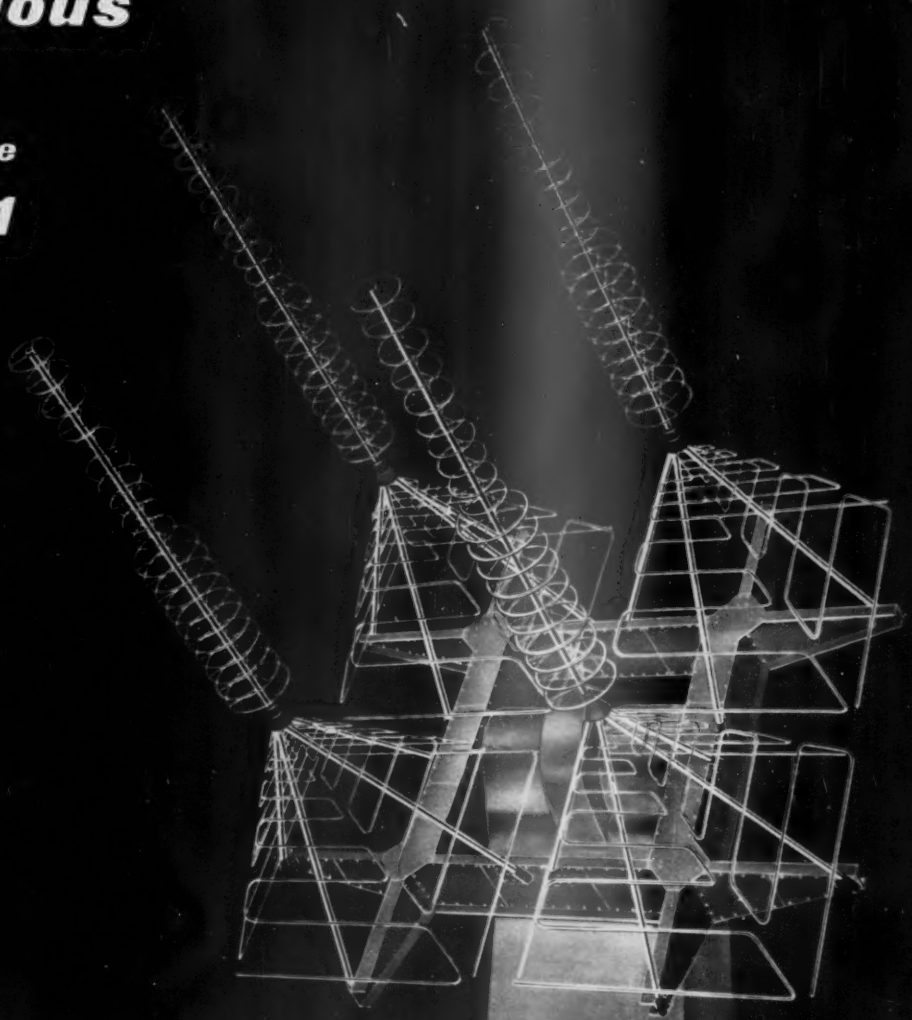

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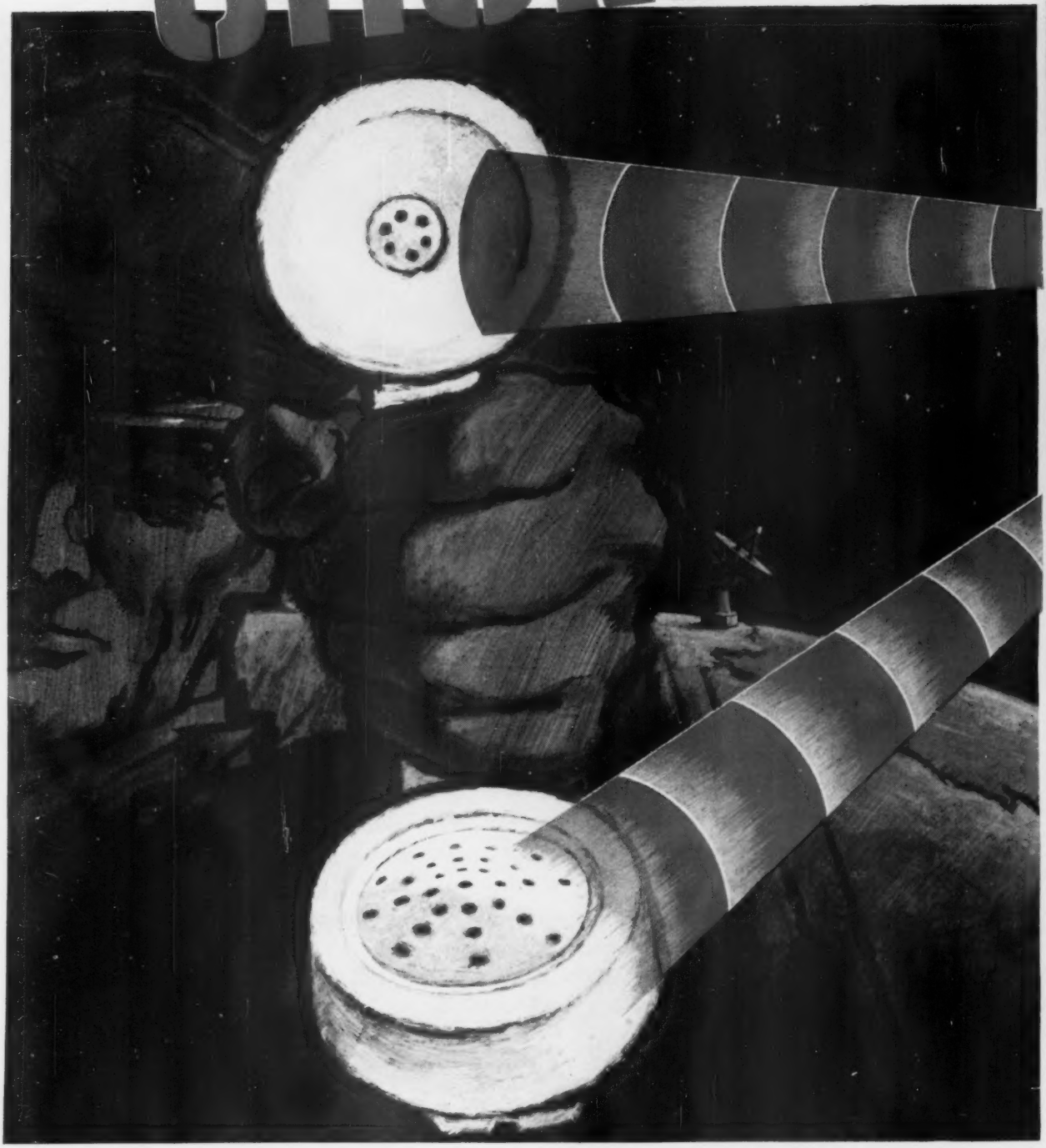

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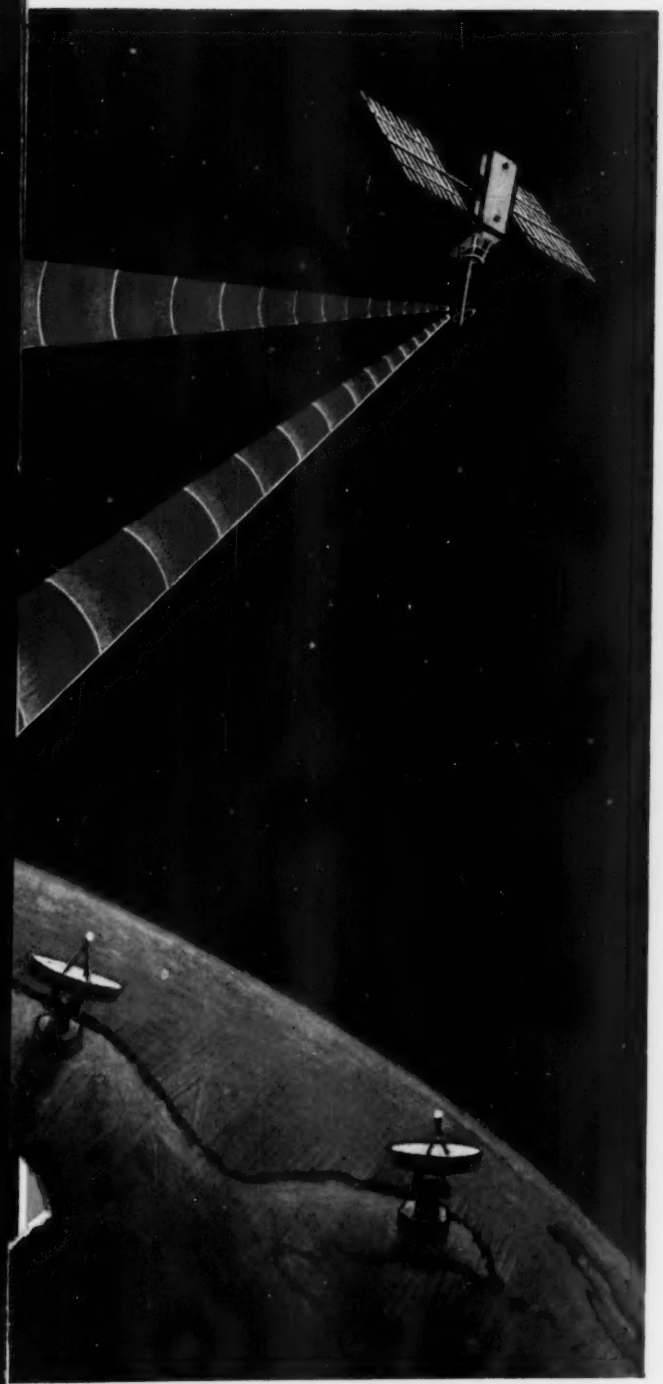

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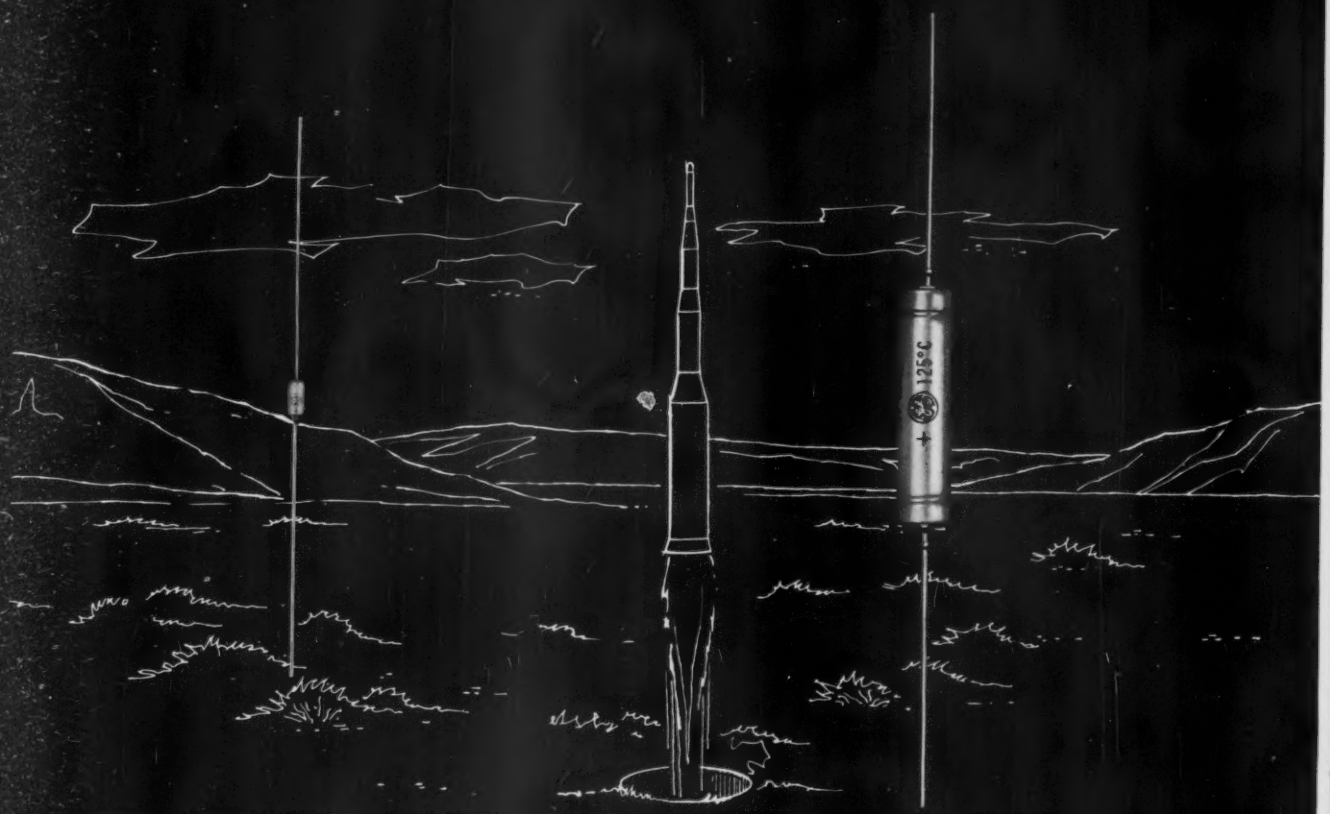

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tages of a continuous maintenance system, which softens the impact of workloads at airframe allowable time by spreading them over a series of periodic checks. Trans World Airlines, for example, plans to utilize overnight layovers for progressive jet overhaul, thus halving the time each aircraft is idled for overhaul during the carrier's slack winter season.

• **High strength steels** used in quantity on jet transports are forcing the carriers to redouble their inspection efforts and apply non-destructive testing techniques even to basic structures. Parts made of steels in the 180,000 to 300,000 psi. heat treat range often fail completely if tiny surface cracks are not promptly detected and repaired. Defects as small as .040 in. should be spotted in the field, Boeing reports, for fatigue cracks and breaks have an extremely high propagation rate in high-strength steels.

• **Quality control** in airline maintenance shops increasingly is being entrusted to line mechanic-specialists rather than to independent inspectors. In Pan American's view, product integrity can best be maintained by "professional lookers" exercising good judgment and equipped with standard inspection tools. But these lookers, the carrier adds, should be independently monitored while they "pay attention to the Indian signs."

• **Maintenance analysis**, the "science" with which airlines attempt to pinpoint where excess labor and material are being expended, cannot fully develop until engineers decide on acceptable limits of component reliability. A "preponderance of evidence," according to Continental, indicates there is a definite correlation between the functioning or malfunctioning of a component or system on an aircraft and other components and other systems on the same aircraft.

• **In-flight failure** and in-flight shutdown rates of the major airline turbojets —Pratt & Whitney's JT3 and JT4 and General Electric's CJ805—still are declining. Stretched out times between overhaul (TBO), some as high as ?,200 hr., reflect this trend. The CJ805, in airline use for 18 months now, had an industry-wide premature removal rate of .59 per 1,000 engine hours in 1960. This year, through August, comparable rate was .39 per 1,000 engine hours.

Continental Cost Control

Continental's cost control system, which the company calls simple and cheap, involves charging every engineering and maintenance expenditure to a specific shop or work location. There are 72 of these "cost centers" within the airline's engineering and maintenance division.

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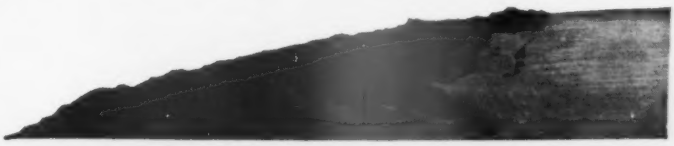
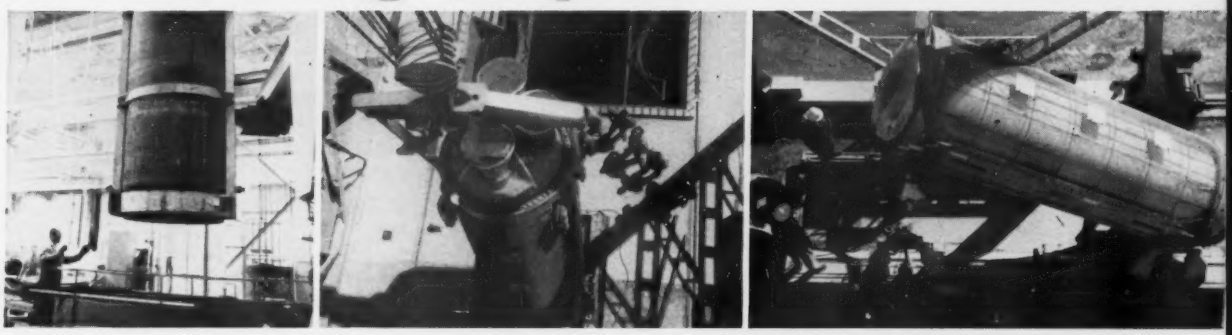
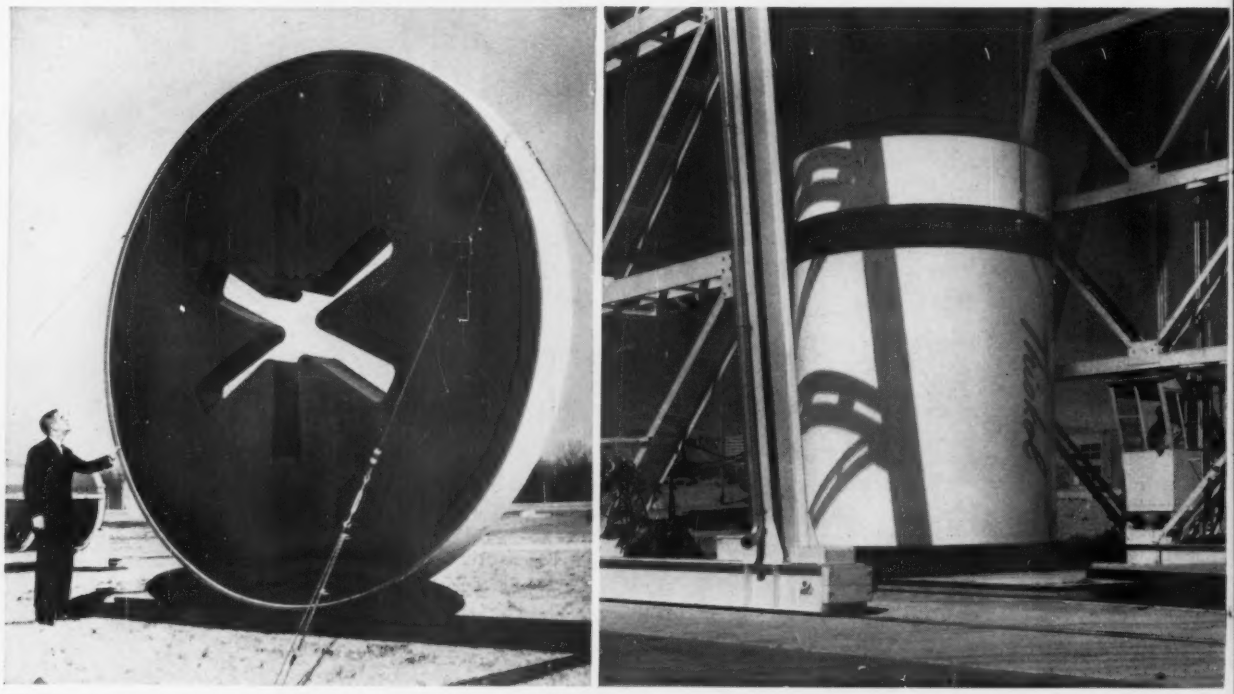


BENCHMARKS in the science ...leading to power for lunar



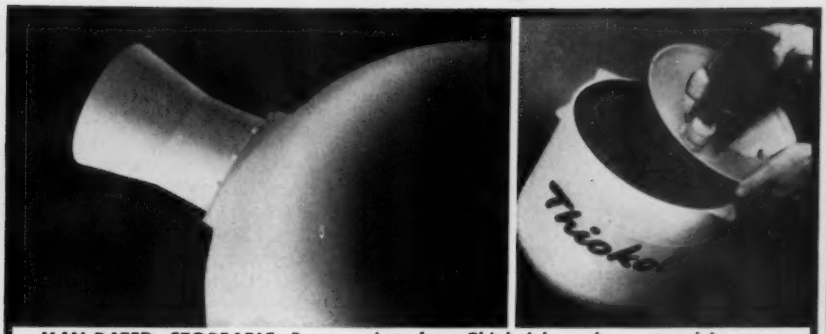
BUILDING THE BIG ONES. *Thiokol Divisions are now producing the most powerful and biggest solids ever flight tested in the free world—first stages of Zeus and Minuteman. Available casting and curing pits, firing bays, handling, test and inspection equipment at these installations have space-engine capacity. These plants, as they presently exist, can support the immediate R&D efforts necessary for an accelerated space booster program. Below: facility prototypes for the production of tomorrow's giant boosters.*



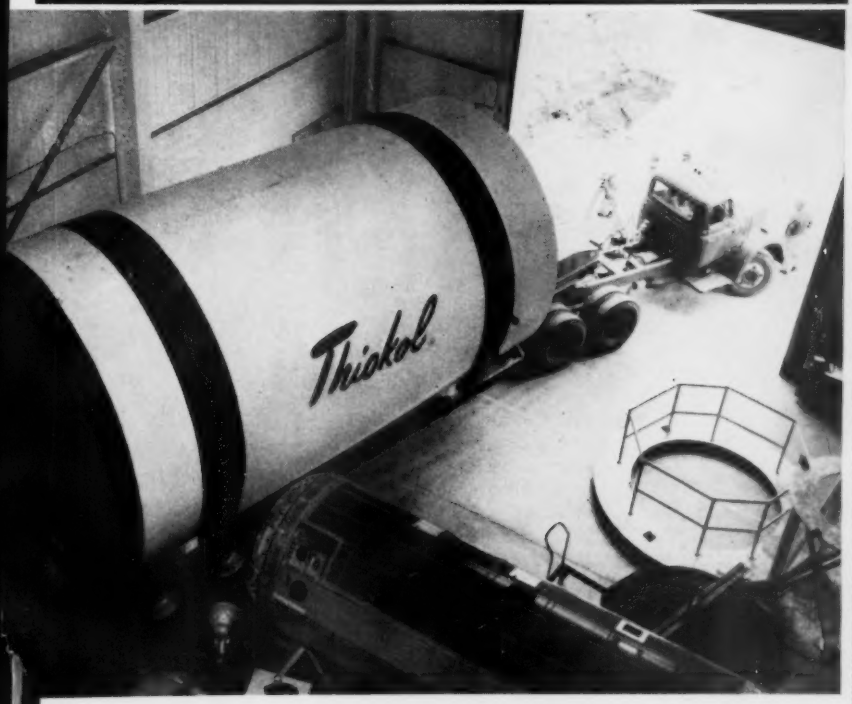
MAN-SAFE, CONTROLLABLE. *From the X-1 to the X-15, Thiokol has been building pilot controllability and start-stop-restart capability into manned rocket engines. The XLR 99, most powerful liquid-fueled rocket aircraft engine ever flown, is successfully carrying the X-15 to new achievements in pilot-safe flight.*

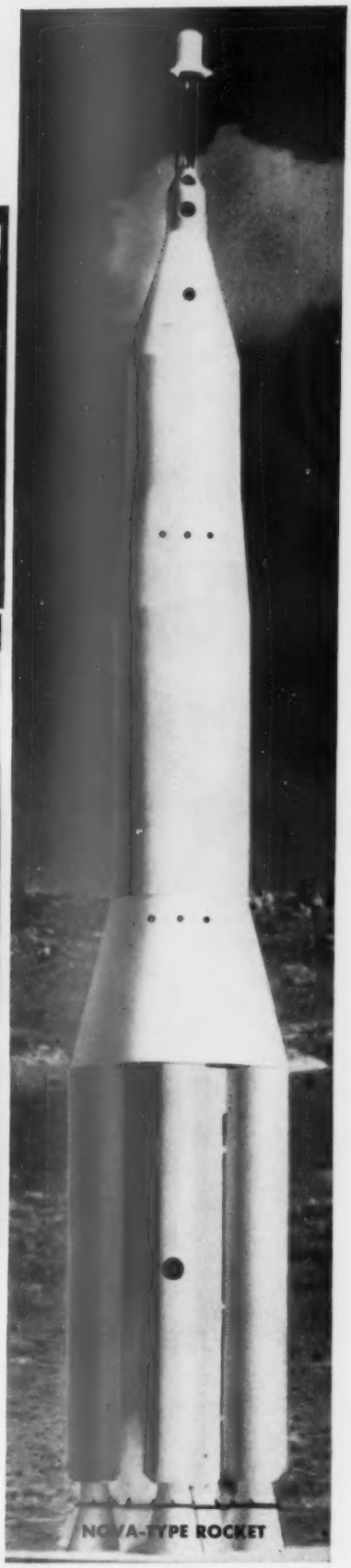
Engineers. Scientists. Creativity is always welcome. Perhaps there's a place for you on the Thiokol team. An equal opportunity employer.

# of rocket propulsion and planetary flight



MAN-RATED, STOREABLE. *Retro rockets from Thiokol have been stored in space and successfully fired again and again. They have been used exclusively throughout Discoverer and Mercury programs, and have proven man-rated reliability by returning the astronauts safely to earth. Thiokol is now developing the retro rocket for the Surveyor lunar vehicle.*





Within today's propulsion technology lie answers to the challenge of manned space exploration. Thiokol has made many significant contributions to advancing the state of the art . . . has scored peak levels of reliability in engine performance, delivery and cost. Working in cooperation with the military, government and industry, Thiokol developed the largest solid engines ever flight tested in the free world . . . and the only man-rated rocket engines on record, both solid and liquid. Thiokol's experience in the design, and production of complete propulsion systems—engines, components, and fuels—its proven scientific, engineering and managerial capabilities contribute to a firm base for America's next great step into space.

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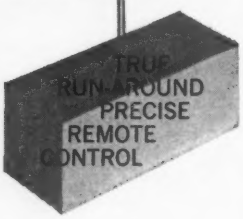
PACIFIC Packaged CABLE CONTROL SYSTEMS



To meet the exacting requirements of controls in today's high performance aircraft and engines—Pacific Scientific has developed "packaged cable control systems."

A complete run-around cable system provides the finest controls for aircraft. The many features and advantages of a properly designed and true run-around cable system can now be incorporated into component packages. This permits installation and application in many mechanical remote control functions and adds the inherent advantages and reliable performance of precise cable control.

Packaged cable control systems are logical outgrowths of Pacific Scientific Company's extensive experience in the field of mechanical control systems and components. Their flexibility can be used advantageously in both straight runs and circuitous routing. Modular construction permits easy installation to flexible mountings, structural members and pressure bulkheads.

Pacific engineers will design a component package to fit your specific control system needs.

Write for complete information today!

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of this numerical code. To determine the reason for a particular expenditure, Continental uses a nine-digit "job number" and requires that individual employes affix it correctly to their labor time cards.

Data thus collected is fed into the carrier's International Business Machines Co. computer, which produces a series of monthly reports. These are forwarded to each cost center, informing it of the number of man hours expended, labor dollars consumed, total cost of the cost center to the company, etc. On the basis of these reports, each cost center prepares a periodic forecast of future expenditures, a forecast that is reviewed by Continental's vice president-engineering and approved by the company's executive department.

As a result of this system, Continental reports, engineering and maintenance was the only division in the company to experience lower over-all costs in 1961 than in 1960.

On the applicability of electronic data processing to airline maintenance, J. M. Wolgast, National's director of maintenance and engineering, suggested that "foremen on the firing line" can often recognize a coming crisis earlier than a computer. Wolgast added:

"In solving a problem we feed EDP all the data we can find, ask it many questions, obtain many answers. With these answers, we remove ourselves to the conference room to develop a solution with implicit faith our little pile of answers is accurate." This process, according to Wolgast, dilutes the quality of lower-level supervision, dulls incentive and saps the vitality an airline needs to compete successfully.

Although trunkline fleets still are being maintained by a variety of systems that range in concept from Continental's almost purely continuous system —a jet is never hangared more than 12 hr.—to TWA's block system in which a base overhaul takes seven days, the trend is toward the continuous method. Airlines concede that continuous maintenance requires larger facilities and expanded stocks of spare components and that it increases aircraft exposure to delays. Nevertheless, they are moving toward it, primarily to boost utilization of their costly new jets.

TWA Overhaul Method

TWA currently maintains and overhauls its Boeing 707s in these four basic steps: a station service check that takes place every 130 hr. and involves 8 hr. out-of-service time; a "minor check C" every 350 hr. and a "major check C" every 1,400 hr., each of which involve 19 hr. out-of-service time; and a base overhaul every 4,000 hr. that eats up seven days.

The carrier's present plans call for accomplishing the base overhaul every two years instead of annually. It also hopes that by completing much of the overhaul during routine checks, overhaul hangar time can be cut to three or four days. This system would enable the overhaul of two to three times the number of jets now being overhauled during the winter.

To gain advance experience, TWA has devised and is using a similar system to maintain the four leased Boeing 720Bs it operates.

To illustrate the advantages of continuous maintenance, Braniff reports that its 707s, now approaching the 5,000 hr. airframe mark, have never been idled more than 16 hr. for anticipated maintenance. Braniff applies the continuous maintenance concept not only to overhaul but also to periodic checks, splitting each into four co-equal parts in order to level overnight workloads.

According to E. R. Moore, Braniff's superintendent of maintenance planning, the carrier will continue to subcontract its turbojet and turboprop engine overhauls as long as this proves economical. As lengthened TBOs and lower utilization of piston equipment produce excess plant capacity, Braniff plans to solicit customer repair and overhaul work.

High-Strength Steels

Benefits gained through maximum use of high-strength steel in a jet transport were detailed here by Boeing. If steels in the 150,000 to 170,000 psi. heat-treat range had been used in lieu of the 220,000 to 280,000 psi. steels in the Boeing 707-120 landing gear, the gear would have been heavier by 950 lb. or 57%, the manufacturer reported.

The dollar value of these extra pounds, Boeing said, ranges from $75 per lb. to $4,000 per lb. if payload must be off-loaded or range is limited by the higher gross weight.

Many of the troubles experienced with the landing gear and other 707 and 720 components should not be blamed on high-strength steel, Boeing maintains. "It is how these steels are used or abused that determines their ultimate usefulness," said Lowell Houtchens, a Boeing engineer.

Although high-strength steel parts are more difficult to damage, Houtchens said, they also are far more susceptible to fail as a result of nicks, scratches, dents and pitting, or "to any physical defect that tends to concentrate stresses." All irregularities, therefore, must be reworked. Even drilled holes must be finished smoothly in a manner that does not change the character of the metal at and near its surface, he warned.

Assuring airline engineers that their redoubled emphasis on quality control was being duplicated by manufacturers,

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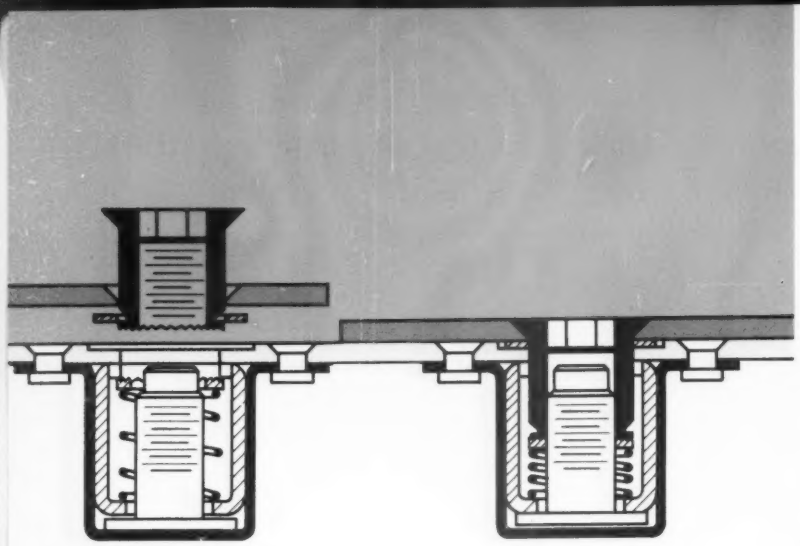

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Floating stud insures positive alignment with mating stud-nut.

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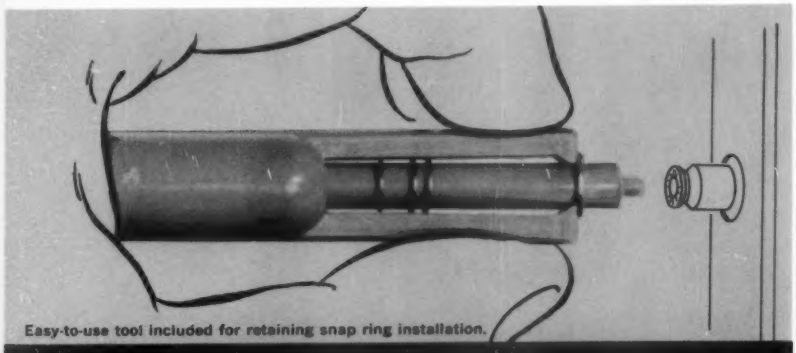
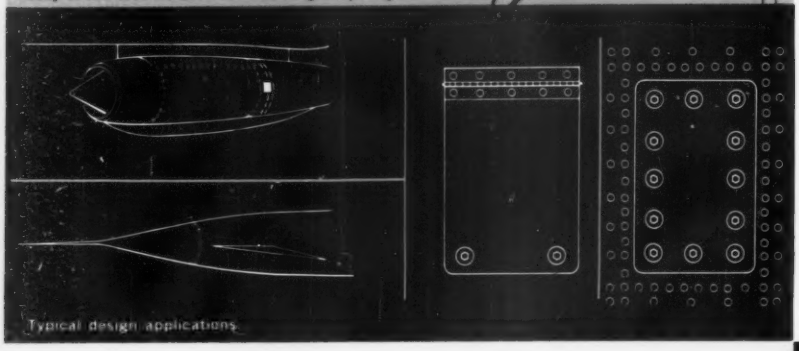
Spring pressure on serrated locking surfaces assures positive lock.



Easy-to-use tool included for retaining snap ring installation.



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■ *100% locking in any position* because it features unique serrated mating surfaces between the stud and nut. The special stud-nut design also permits considerable sheet misalignment.

■ *Receptacle contains only 6 parts,* and this means trouble-free performance and long life.

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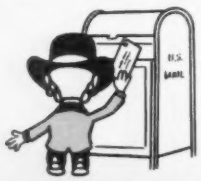

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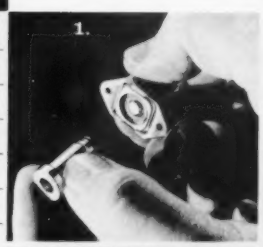
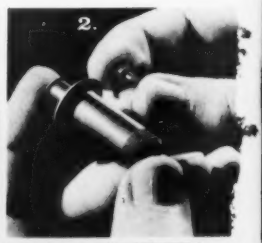
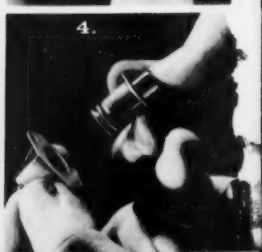
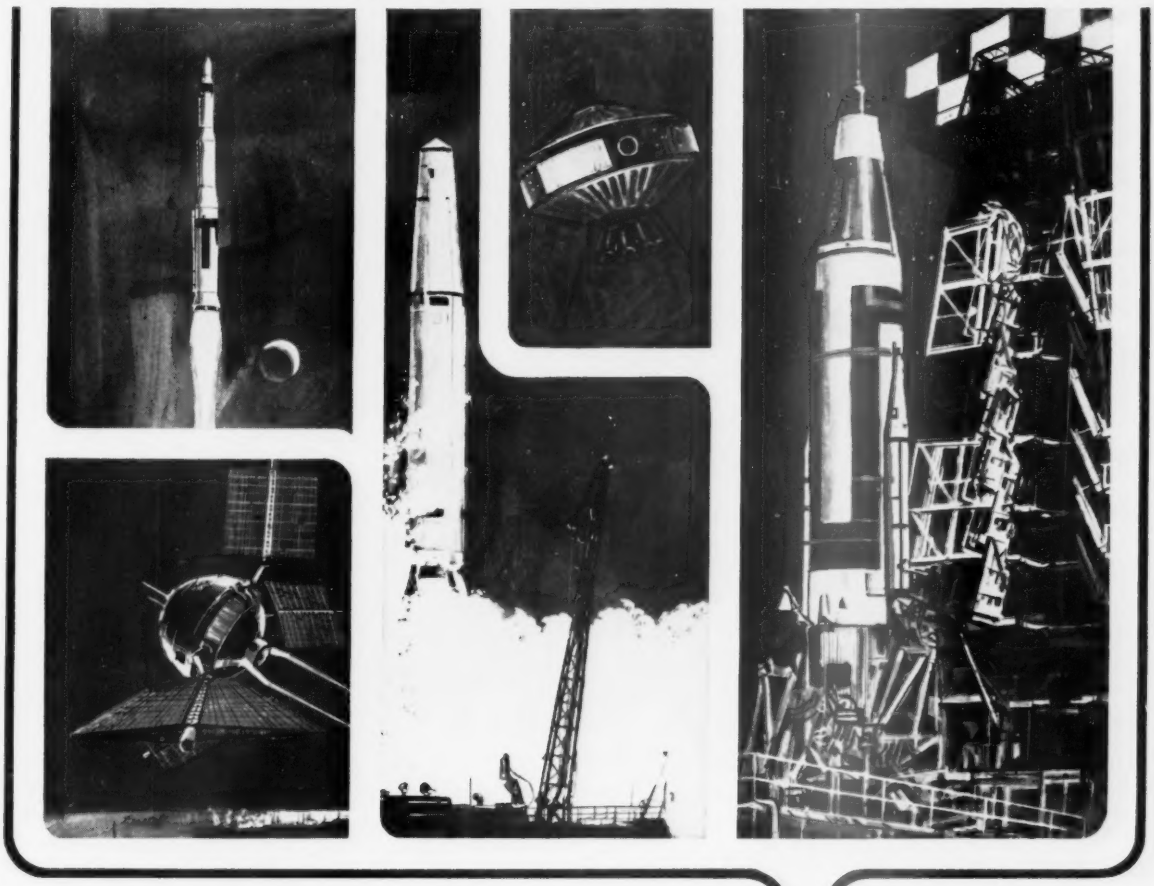






CAREERS IN SPACE TECHNOLOGY LEADERSHIP



Of particular interest to engineers and scientists is the continuing growth and diversification of Space Technology Laboratories, Inc. What is now STL was founded as the Guided Missile Research Division of the Ramo-Wooldridge Corporation in 1954, when the Ballistic Missile Program was given highest national priority. ■ Assigned contractual responsibility for the program's systems engineering and technical direction, STL has grown in parallel with the need for its capabilities – from a small group of engineers, scientists and administrators to an industrial organization with a professional staff numbering more than 2,000 with 2,500 supporting personnel – from its initial headquarters in a suburban Los Angeles schoolhouse to the ultra-modern STL Space Technology Center nearing completion on a 110-acre site at One Space Park, Redondo Beach, California, close to Los Angeles International Airport. ■ During its years of Space Technology Leadership, STL has contributed importantly to the management of a program that, in a successful race against time, has given this nation the Thor, Atlas, Titan and Minuteman ballistic missile systems. At the same time, STL has been called upon to design, fabricate, instrument and successfully launch Pioneer I, Explorer VI and Pioneer V – all of which were tracked and commanded by STL's world-wide space communication network (SPAN) – and to contribute to the management of the Transit 1B, Transit 2A, Transit 3B, Courier 1B and Tiros programs. ■ Today, STL in addition to its continuing role in the USAF Atlas, Titan and Minuteman programs, is performing research, development, design and construction for three Orbiting Geophysical Observatories (OGO), as well as project coordination and systems planning for Project Relay, both for NASA; and participating in the Army Advent communication satellite project. STL's continuing program of original and applied research covers a broad spectrum of technical disciplines including particle physics, solid state theory, guidance space physics, communication theory, propulsion and power, and electromagnetic systems in the infrared, ultraviolet and microwave regions. ■ The expanding activities of STL create immediate career opportunities in Southern California and at Cape Canaveral for engineers and scientists of talent and vision. All qualified applicants are invited to communicate with Dr. R. C. Potter, Manager of Professional Placement and Development. STL is an equal opportunity employer.

Career opportunities exist at STL for qualified engineers and scientists in support of these programs:

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The cost of miniaturization just dropped 20%

Trends can be overpowering. Once established, they're tough to reverse.

Take the cost of miniaturization, for example. As electronic packages get smaller, price tags get bigger. No one seems surprised. It's a trend.

There's a reason, of course. Tiny things are hard to build, especially within space-age reliability requirements.

Amphenol designers decided that if ever a trend needed reversing—it was this one.

"How" was another question. They knew that conventional miniaturized pin and socket connectors were about as small as they were ever going to be. The spring member in the female contact (necessary for a snug, low-resistance connection) took up valuable space and set a lower limit for practical center-to-center contact spacing. The spring was obviously holding up progress in miniaturization. It had to go.

So, it went.

►Amphenol designers developed the Wire-Form Poke-Home® contact, a male contact that supplies its own tension and can be crimped or welded before assembly. Overnight, contact spacing plunged from .175 inch to .100 inch. And, best of all, the new contact was less costly to manufacture. (It's built on automatic equipment.)

The trend reversal was well on its way. Amphenol designers had a new contact—the next step: putting it to work in connectors.

To answer the need for an economical micro-miniature rack and panel connector, the Micro-Rac was unveiled. Space-saving Wire-Form contacts and an integral-body-dielectric construction made it possible to pack 20% more connections in the same space—and at nearly half the previous cost. As for reliability, after 1,000 repeated insertion and withdrawal cycles, the Micro-Rac retained its original low resistance characteristics.

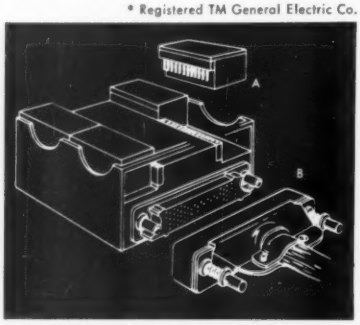
►Next came the Strip Connector, six-inch lengths of Lexan* plastic with contact holes on .100 inch centers. A do-it-yourselfer's delight, strips can be cut and stacked to suit hundreds of applications where a connector is a must—but for which no other economical connector exists. Example: strips can be stacked to form micro-miniature programming boards or instrumentation terminations. They also can be used as economical tape cable connectors, modular connectors, logic card connectors, to mention a few.

Wire-Form contacts can be used separately, too. Example: contacts can be crimped or welded to modules and plugged into special eyelet-type receptacles on printed circuit boards. Non-modular components, such as transistors, become pluggable by crimping Wire-Form contacts to their leads.

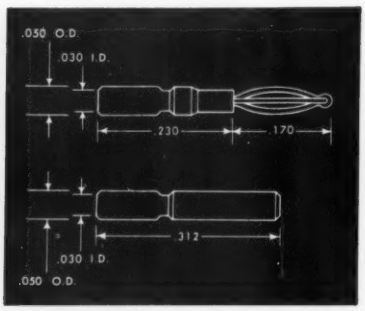
And that was that. The trend was reversed.

►If you would like more information about Wire-Form Poke-Home contacts, Micro-Rac 52- and 104-contact rack and panel connectors, Strip Connectors (or any Amphenol Connector for that matter) call your Amphenol Sales Engineer. Or, write to Dick Hall, Vice President, Marketing, Amphenol Connector Division, 1830 S. 54th Avenue, Chicago 50, Illinois.

* Registered TM General Electric Co.

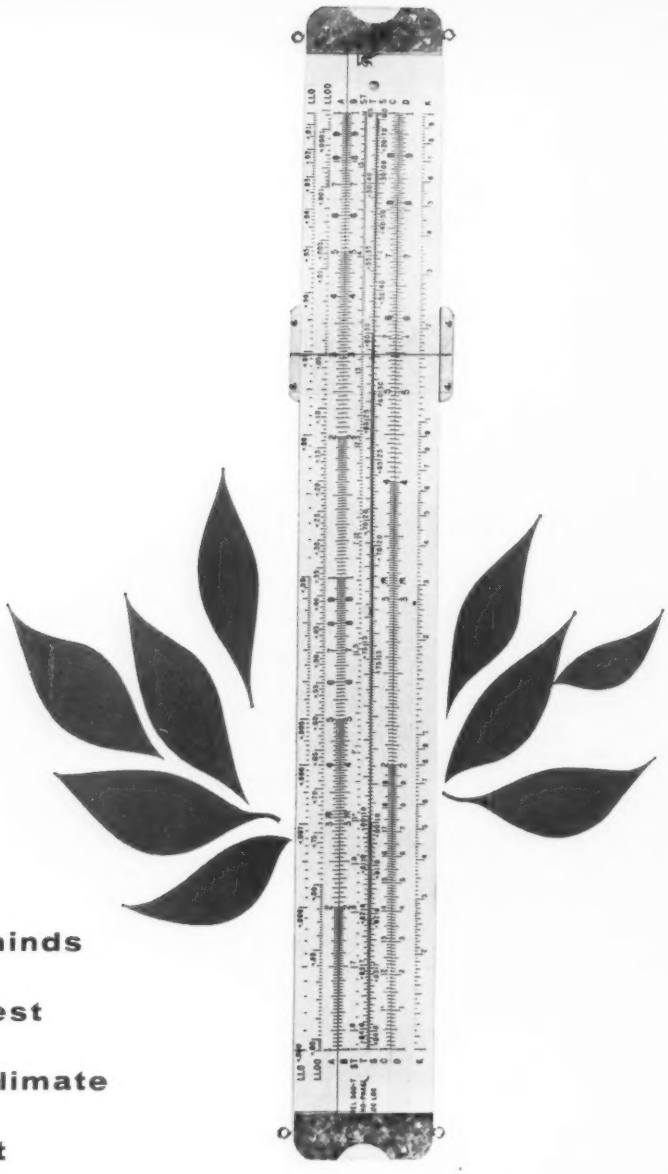


The Amphenol Wire-Form contact at work. Multi-purpose Strip Connectors (A) connect modules to chassis; Micro-Rac Connectors (B) connect chassis to cable assembly.



Acting like four spring fingers, Wire-Form beryllium-copper beam sections assure a low resistance connection (.0025 to .0030 ohm) even after 1,000 insertion-withdrawal cycles.

AMPHENOL **Connector Division** / Amphenol-Borg Electronics Corporation



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ENGINEERING WRITERS with 2 years' college and 3 years' experience in preparation of TCTO's; operations, maintenance, and overhaul manuals.

SYSTEMS ENGINEERING: BS degree required, advanced degree desired, in engineering or related field. Two to five years of experience, including missile or similar background in testing, methods of operation, systems analysis, and evaluation. Assignments will include establishment of test requirements, determination of factory tolerance structures, and evaluation of field testing.

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Technical openings also exist in other specialties. Write Mr. R. M. Smith, Industrial Relations Administrator-Engineering, Dept. 130-90, General Dynamics | Astronautics, 5703 Kearny Villa Road, San Diego 12, California. (If you live in the New York area, it may be more convenient to contact Mr. T. Cozine or Mr. E. Hart, General Dynamics | Astronautics, One Rockefeller Plaza, New York City, Telephone CIrcle 5-5034.)

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R. G. Bentzinger of Pratt & Whitney reported that in 1960 his company's service records group produced 1,465 formal reports based on 132,347 field service representatives' reports and wires plus "industry sources." Data flow in 1961 promises to exceed these figures, Bentzinger said.

As of Aug. 31, Pratt & Whitney airline turbojets had logged almost five million hours of airline service. Since introduction, the turbojets' in-flight shutdown rate per 10,000 engine hours for all causes has been 1.134. Engine-caused in-flight shutdowns per 10,000 engine hours numbered .488. Bentzinger also reported that:

• **Rapidly increasing TBOs** expose the average engine to an ever-increasing "age." As this age increases, so does the rate of in-flight shutdowns. The JT3C-6, for example, is shut down almost three times more frequently at a time since overhaul of 1,500 hr. than at a time of 500 hr.

• **Cost of overhauling** all types of turbojets has proved to be substantially less than Pratt & Whitney predicted. First Pratt & Whitney forecasts indicated that parts scrapped at first overhaul would equal 8% of the engine's price, at second overhaul 10%, at third overhaul 12%. Actual costs, however, averaged 3 to 5% of engine price through fifth overhaul. In terms of dollars expended for materials, this figure equaled about $5,000 to $8,000 without service policy credits.

• **Pratt & Whitney has issued** 2,392 engineering changes to refine the JT3C-6 engine since it received an FAA type certificate on June 19, 1957. Since the first of 1958, the manufacturer published 41,452 master pages of service, maintenance, overhaul and accessory manuals, service bulletins and parts digests for its commercial jet engines.

CJ805 Overhaul Rate

General Electric, Pratt & Whitney's major competitor in the airline turbojet market, predicted that its CJ805-3 engine would earn TBO increases at the rate of about 200 hr. per airline user every 90 days until overhaul times of about 2,000 to 2,200 hr. are attained. The reason, according to GE, is the engine's in-flight shutdown rate which "has been better than some new turbine engines." Highest airline CJ805 TBO is 1,400 hr.

To satisfy FAA's Turbine Engine Time Control Program, the CJ805's adjusted in-flight shutdown rate in 1960 was .18 per 1,000 engine hours. Rate in 1961 to date is about .07 per 1,000 engine hours, which qualifies the engine for a 200 hr. TBO jump every three months.

During the first 16 months of airline CJ805 operation, none of the engines prematurely removed required overhaul; all could be repaired, GE's T. J. Harris, manager of maintenance and operations engineering, reported. Convair 880 delays of more than one minute because of engine-caused mechanical reasons have averaged less than 0.5% and flight cancellations about .033%, he said.

In a shop overhauling at least 20 engines per month, initial overhauls will consume about 1,500 man hours, GE data indicates. When about 200 CJ805s have been overhauled, this figure should drop to 900-1,000 man hours, General Electric said.

CJ805 Overhaul Cost

First overhaul of a CJ805, according to GE, will cost about $7,800 per engine in parts. This equals a material cost per flight hour of about $6.50 on a 1,200 hr. TBO engine, a cost that confirms GE's original estimates.

Through Aug. 31, airlines had reported 88 premature CJ805 removals. Engine faults that caused these can be divided into seven basic categories, GE reported, six of which cover two-thirds of the removals.

Prime problem with the powerplant since its introduction has been number one bearing failure combined with front frame distortion. Of the total engine removals, this was the cause of 25%. Because the front frame of the CJ805 is a magnesium casting, improper or excessive use of the engine's anti-icing system or high anti-icing temperatures result in distortion and bearing failure.

However, GE states that an anti-icing air temperature limiting device, and other corrective changes, are being installed on operating engines to eliminate or minimize the problem.

Failure of the first stage turbine shroud or air seal was the second-ranking cause of CJ805 premature removals, resulting in 13.

As a fix, GE developed a new honeycomb-type shroud and installed it in all CJ805s. According to GE spokesmen, this problem has been "completely eliminated."

Third most frequent cause of CJ805 premature removals has been turbine bucket failure, which occurred in nine engines. Five affected the first stage turbine, four the third stage. Seven removals were the result of a faulty tab washer in the inlet and transfer gearbox assemblies. Failure of a weld joint on the vent tube for the ninth stage compressor's air was traced as the cause of five removals. Compressor vane and blade failures caused four others, while 16 separate and miscellaneous causes led to 28 premature removals. For all, fixes have either been developed or are in process.

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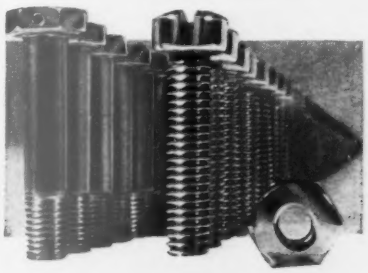

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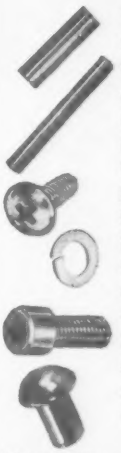

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Bell Helicopter Evaluating Rigid Rotor

By Erwin J. Bulban

Hurst, Tex.—Bell Helicopter engineers have developed a rigid rotor to the point where they believe they can use the system in a range of rotary-wing aircraft from small machines to flying cranes.

Rigid rotor benefits also are applicable to tilt-rotor types of vertical takeoff and landing vehicles, the company reports.

Feeling here is that the system provides benefits so important that there is a "good chance" that the rigid rotor concept—which actually dates back to pioneer helicopter days—could, in its revived form, replace present articulated single-rotor systems.

Values Established

Bell's company-financed test program, which has been refining the current system since first full-scale flight tests here in 1957, has just about exhausted the capabilities of the standard Model 47 testbeds utilized so far, but has definitely established the rigid rotor's practical values, leading Bell management to provide additional funding to build optimized components that will more closely approximate actual performance that can be achieved.

Bell probably will start flying its optimized system this winter, Vice President-Engineering Bartram Kelley told AVIATION WEEK. Testbed thus far has made no attempt to match the rotor and powerplant, compromising aerodynamic performance because of having too much rotor for the power available. The three-blade rigid rotor test system comprised the addition of a standard 11-in.-chord Bell 47 blade to a helicopter designed for a two-blade configuration. The advanced system will utilize three eight-inch-chord blades of thinner airfoil section, plus cleanup of attaching hardware and other components, providing a marked reduction in drag.

NASA Interest

National Aeronautics and Space Administration also has contracted with Bell to supply an improved rigid rotor system and set of blades to its Langley Laboratory so that the agency can conduct an independent evaluation program.

Since the rigid system is such a basic approach to the helicopter rotor design problem, it undoubtedly has been actively studied by all of the major manufacturers, plus untold other designers in this field. Among contemporary programs, the Lockheed helicopter test vehicle (AW July 31, pp. 26-27) has been the only one to garner public notice. Indications are that the Navy's interest in this development has spurred Bell to discuss its long-time research in the same field.

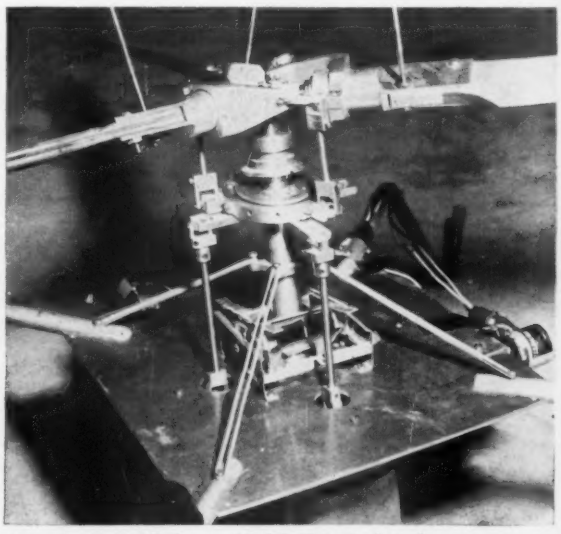
The rigid rotor is no revolutionary breakthrough—an engineer close to the program ventures that, because of its history, there may be little remaining that is still patentable. Because of its basic simplicity, it was used on several of the earliest helicopter projects, although the failures of these, Kelley believes, were for reasons other than the rigid rotor system. Nonetheless, he said, development of the autogiro resulted in use of the articulated rotor, and successive revival of the helicopter basically picked up rotor development from the autogiro, leading to the complex systems in use today.

Several post-World War II examples of rigid rotor use can be found—the Landgraf twin-rotor design, for example, with a more recent specimen being the rotor-propellers of the tilt-wing Vertol VZ-2.

System's Layout

The system, simply put, rigidly fastens the rotor hub to the mast, much as the conventional fixed-wing aircraft's propeller is attached to its hub, with the only bearings being in the rotor blade pitch change mechanism.

This differs markedly from Bell's conventional rotor system—generally termed a "semi-rigid" system—in that Bell mounts its hub on a gimbal, permitting the rotor to tilt or see-saw for cyclic pitch, being rigid in collective pitch. In the rigid rotor system, this independent tilting of the rotor is effectively locked out. Part and parcel of the rigid rotor is fastening the blades to the hub, without hinges, developing toward maxi-



INCREASED CENTER OF GRAVITY travel made possible by use of rigid rotor system, shown installed on a Model 47 testbed, is demonstrated (left) by Bell Helicopter Co. Vice President-Engineering Bartram Kelley. Flight characteristics of three-blade rotor with high degree of rigidity were tested by Bell engineers using electric-motor-powered model (right) in early 1960.

mum stiffness in the system, except for the negligible amount of flexibility in blade flapping due to the limits imposed by practical construction technique where weight limitations would out-run any minor improvements possible by improving stiffness. In fact, some blade flapping flexibility probably is desirable as a means of unloading some of the stresses imposed by loading moments directly into the mast.

In practice, helicopters of the size of the Model 47 probably could have blades built with a high degree of stiffness before the structural weight ratio would become prohibitive, Kelley believes. Much larger machines developing higher stress loads would naturally require more flexibility to relieve these, and blades of these sizes would require an inordinately heavy structure anyway.

Of major importance in the system is hub-to-mast and blade-to-hub rigidity.

Key benefits of the rigid rotor system outlined by Bell engineers include the following:

• **Apparently unlimited** center-of-gravity travel for the single-rotor helicopter configuration, with indications that this indiscriminate loading capability will be available over the entire mission envelope. Kelley himself graphically demonstrated this characteristic of the rigid rotor machine when, during a flight test of the current development vehicle, it was hovered close to the ground and he reached up and grasped the tailboom considerably aft of the cabin section. The pilot reported that only a slight stick movement was necessary to compensate for this weight imbalance. The very characteristic that makes the rigid system so attractive to the single-rotor helicopter weighs against its use for tandem configurations, engineers assert, since variation of center of gravity of this configuration would introduce opposing moments into tandem rotors that would tend to conflict with each other.

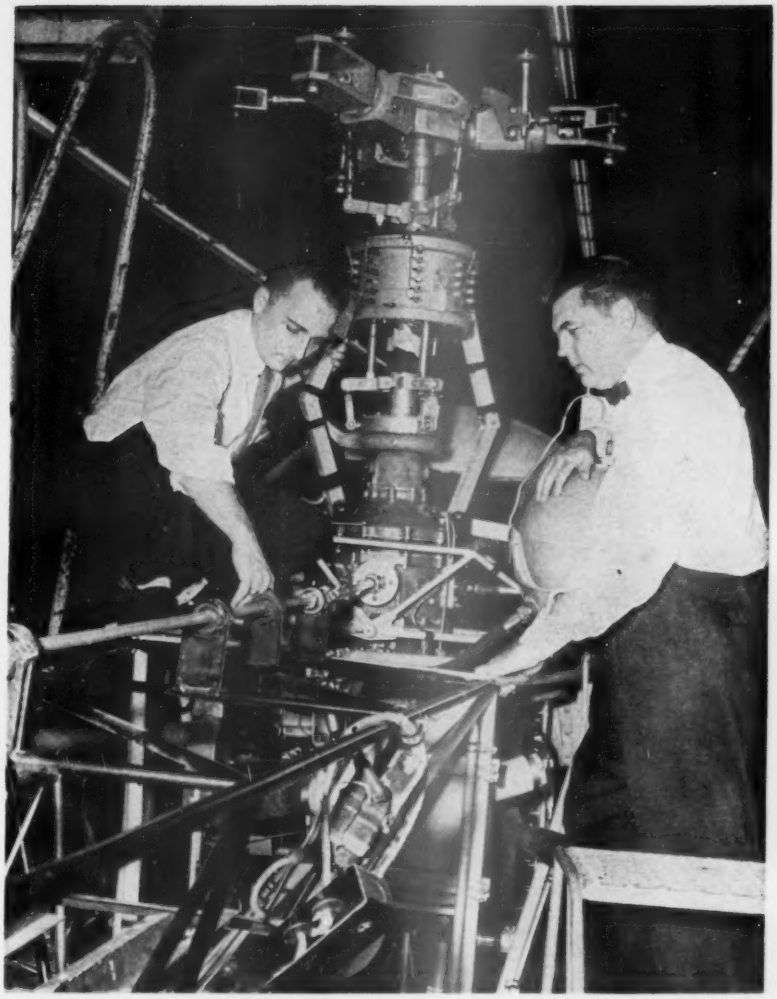
• **Simplification** of rotor components by reducing the number of parts needed per blade, particularly bearings, in addition to reduction of components in hub systems. Bell estimates that elimination of bearings in the rigid system, aside from those needed for blade pitch change, would reduce by about half those required in its conventional semi-rigid Model 47 rotor system and could mean a reduction of up to two-thirds the number needed in other rotor systems. It is this marked simplification of parts, maintenance time and skills required that particularly attracted the interest of Navy in the Lockheed machine.

Actual weight savings over conventional systems probably would be negligible, Bell believes, since the principle of rigid rotor operation puts load moments directly into the rotor mast and transmission and some strengthening of these components probably would be necessary. However, this is seen as a nominal consideration and one easily handled. Elimination of the see-saw tilting of the rotor, particularly in low-slung, small helicopters, would allow persons to approach and leave the aircraft while the rotor is turning slowly without fear of decapitation. Blade stop systems, used normally to prevent these rotors from striking the structure, also could be eliminated.

• **Markedly improved handling** qualities will be provided the pilot due to rapid rotor response to stick motion provided by the rigid system, which feeds blade tilt moments directly and rapidly into the mast. This characteristic would reduce over-control tendencies that are engendered by lag of current articulated and semi-rigid rotors. Although flight stability was not one of the objects of rigid rotor research, analysis indicates that a rigid rotor would be stable without the use of rotating masses, gyros or other artificial means. The testbed, although aerodynamically deficient because of its relative crudeness, has shown a marked degree of inherent stability, particularly in hovering, Kelley notes, adding that it appears to be as good or better than the standard Model 47 fitted with a stabilizer bar.

This combination of inherently good stability, combined with rapid maneuvering, provides decided piloting advantages for the rigid rotor system, since often in the past hovering stability has been gained at the sacrifice of maneuverability and vice versa.

To further investigate these characteristics, Bell had pilots of varying degrees of experience fly the testbed, including beginners. General consensus of opinion was that for blind flying work, some form of stability augmentation probably would be required, because for this type of work, the rapid maneuverability dic-



RIGID ROTOR HUB providing a high degree of stiffness in system is shown in shop minus blades. Tail rotor shaft is being inspected by Bell engineers Frank Wagner (left) and Wesley Cresap. Vertical linkage system only provides blade rotation for pitch change angle.

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tated a pilot assist in the form of stabilization.

The company's early approach to the rigid rotor was to start from the "soft" end of the spectrum and work toward extreme rigidity in both hub-to-mast and blade attachment. Initial effort was to modify a gimbal-mounted three-blade rotor, inserting mast moment springs to resist rotor flapping motions and introduce a bending moment into the mast.

Soon afterward the company designed and built a "flex-beam" rotor, in which each blade was individually secured to the mast using a flexible steel member, which was rigid chordwise but permitted restrained blade flapping. This system differed from the earlier mast-moment spring configuration where the blades were not affected individually and inclination of the entire three-blade rotor caused deflection of the springs. The flex-beam rotor eliminated all bearings except those used for blade pitch change.

The flex-beam system was flight-tested successfully throughout 1958 and encouraged the company to study the possibilities of going to maximum rigidity in the entire system. Concurrently with analytical work, a model program was utilized to investigate possible dynamic problems and indicated that a high degree of rigidity was entirely feasible.

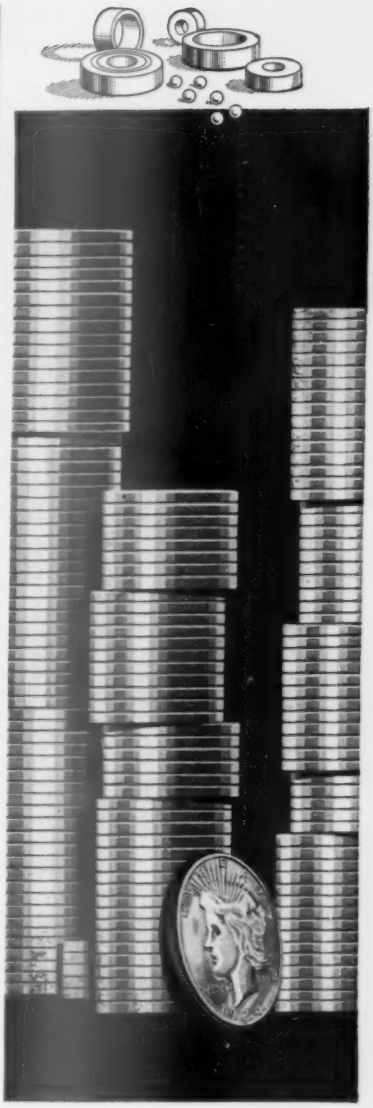
Blade Flexibility

Bell studies on blade flexibility have covered the entire spectrum from a point where the blade mounting was so "soft" that the tips would nearly touch the tail except for bracing, to the highest degree of rigidity practical; analytically, with models, and in full-scale.

Kelley asserts that Bell engineers now know what blade flexibilities and rotor rpm. are desirable for the entire foreseeable spectrum of single-rotor helicopters. Actual flight testing of a variety of flexible configurations will be aided by incorporating a variable-rigidity into the forthcoming optimized test vehicle so that this study can be carried on with a minimum of downtime.

Flapping flexibility of blades introduces some complications in rotor dynamics analysis, Kelley admits. The rigid rotor acts as a gyroscopic mass and the usual simple whirling speed divides into two speeds. Flexibility introduces periodic coefficients that digital computation indicates may require some deliberate introduction of a small amount of flexibility at the hub spindle. He points out that analytical work to date has kept pace with flight testing and that the project has encountered no structural problems and that there have been no blade failures with the three-blade rigid rotor system.

A two-blade rigid rotor system poses



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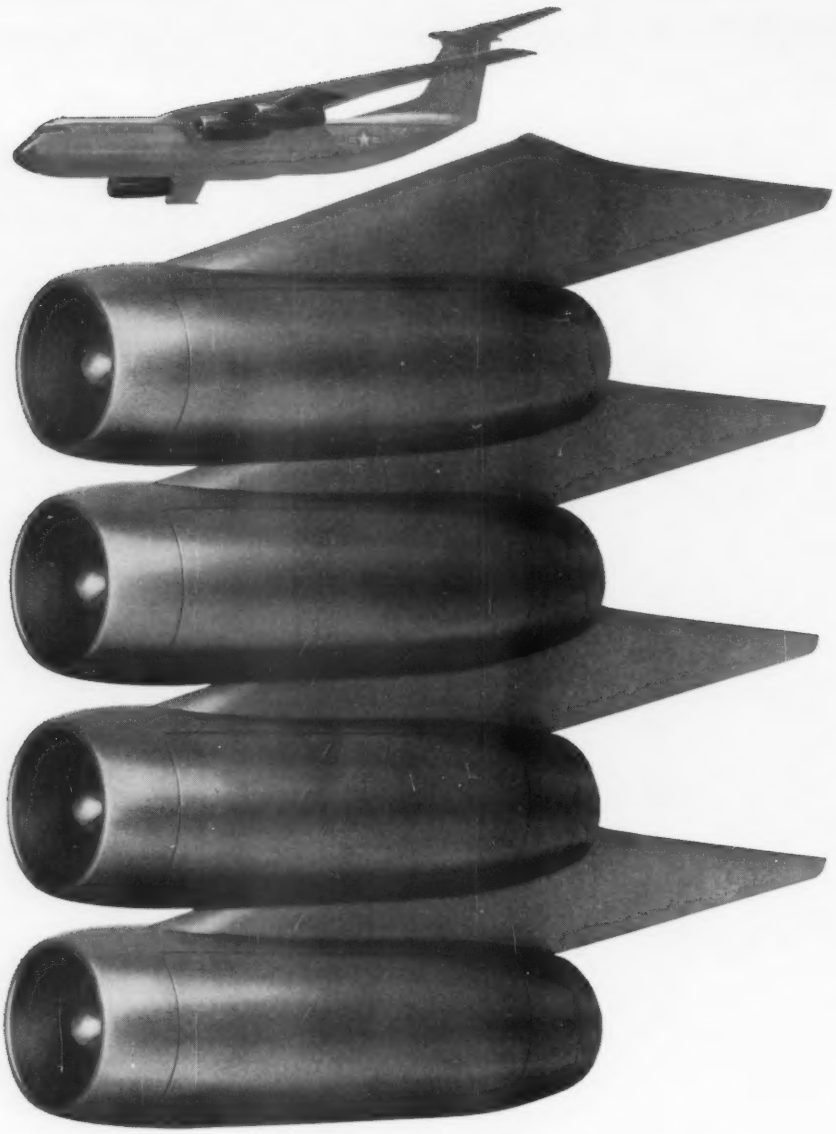

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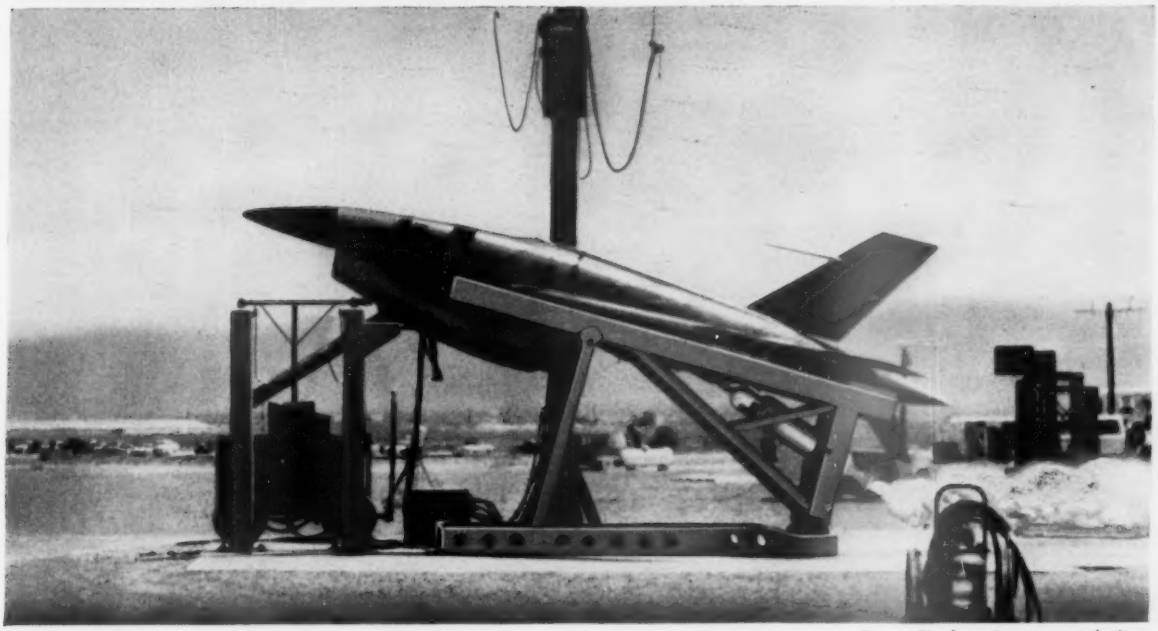

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a more formidable problem, one of mechanical dynamics, rather than aerodynamics, that is only recently beginning to be appreciated. Basically, a two-blade rigid rotor has mirror symmetry about a vertical plane, but not a vertical axis. On rotation, non-symmetrical gyroscopics are quickly developed that transfer to the rotor mast in the form of violent shimmy and rotation that become uncontrollable. Experimental work by Professors P. J. Brossens and S. H. Crandall of Massachusetts Institute of Technology, investigating this basic phenomena purely on a research basis with a small non-aerodynamic rigid rotor has been one study showing up this complex problem and the lack of knowledge of the dynamics involved.

Bell engineers, in the course of their studies, evaluated a full-scale two-blade rigid rotor on a tied-down Model 47 helicopter, which nearly tore itself apart in less than five revolutions from start of blade rotation, while still at half speed of about 160 rpm.

PRODUCTION BRIEFING

Northrop Corp. has received a letter contract from USAF for approximately $64 million for an additional 144 T-38A supersonic jet trainers, with initial funding of $24 million. Production rate will reach 12 aircraft per month in December; the new aircraft will be produced between December, 1962, and November, 1963.

Lockheed P3V-1 Orion anti-submarine warfare aircraft has completed two weeks of Navy preliminary evaluation tests, including combat-type take-offs. First delivery to fleet units is scheduled for mid-1962.

Autonetics Division of North American Aviation, Inc., has received approximately $12.5 million in contracts from International Business Machines Corp. for terrain-avoidance computers, test controls and auxiliary equipment for Air Force B-52 bombers.

Hydro-Aire Co., Burbank, Calif., will supply main and nose wheel landing gear anti-skid systems for Boeing's 727 jetliner under a $540,000 contract.

Denny Hovercraft, Ltd., has been formed as a subsidiary of William Denny and Bros., British shipbuilding firm, to build the Denny Hovercraft vehicle (AW Oct. 16, p. 108).

Lear, Inc.'s Lear-Romec Division, Elyria, Ohio, will supply fuel boost pumps for USAF's B-52Hs under contracts totaling $275,963 from Boeing.

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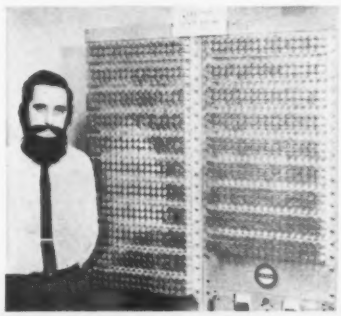

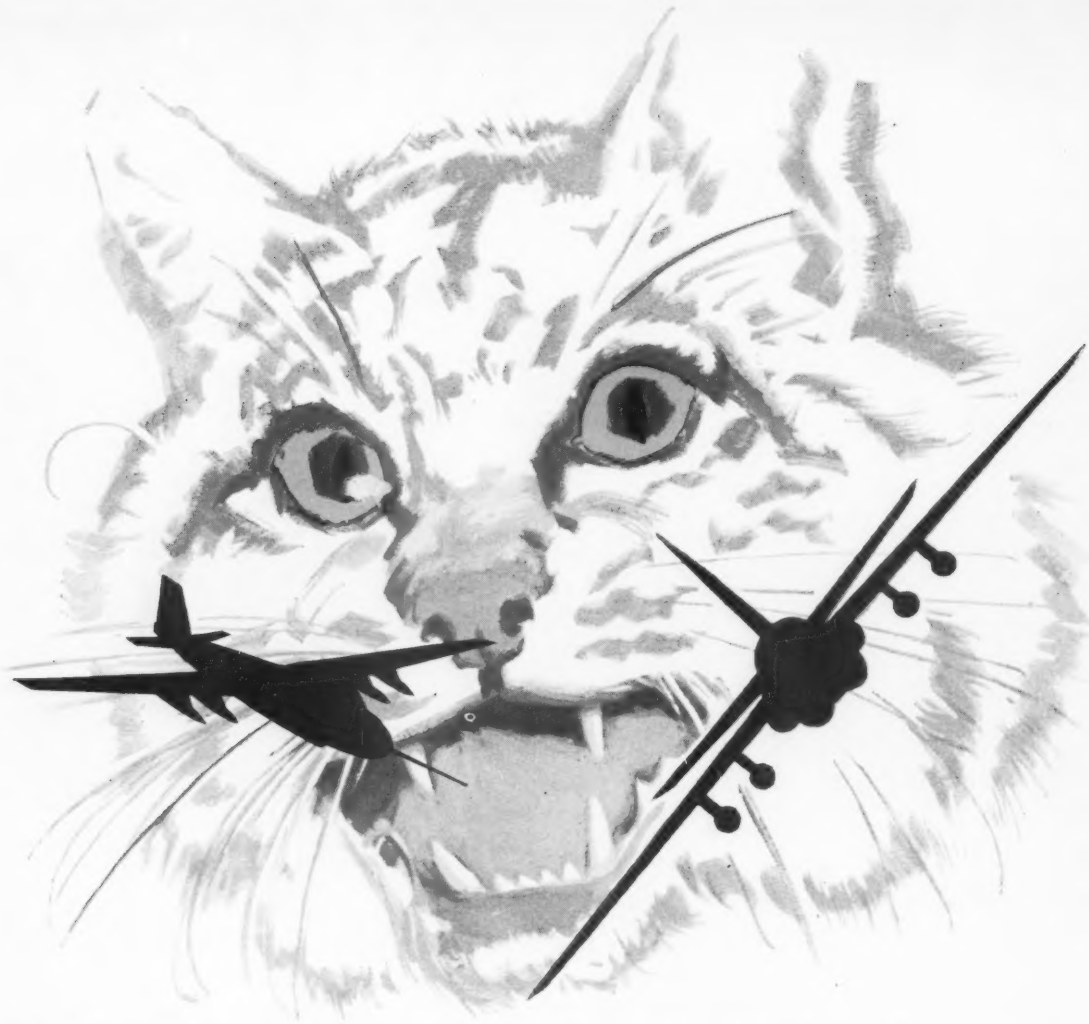

"Cat's Eyes" for the Navy's Intruder

The Grumman carrier-based A2F-1 Intruder is an elusive, low-flying aircraft that can follow a course around hills and other hazards as it swoops in toward its target. The pilot "sees" his course and target clearly even in midnight darkness . . . or in spite of severe weather conditions . . . by Norden's Search and Terrain Clearance Radar.

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Lunar Radioisotope Generator Detailed

By Barry Miller

Las Vegas, Nev. – Radioisotope-fueled thermoelectric generator capable of providing up to 25 electrical watts over a four-month period on the moon's surface to power instruments and electronic equipment aboard the nation's first unmanned series of control-landed lunar spacecraft (Surveyor) was described here during the recent International Symposium on Aero-Space Nuclear Propulsion.

The generator, which employs the heat of a radioisotope, curium 242, as the energy source for a thermoelectric conversion system, was designed by Nuclear Division of the Martin Co. in consultation with Hughes Aircraft Co. The latter is prime contractor for National Aeronautics and Space Administration's Surveyor soft, or control, landed spacecraft.

As outlined in a report by engineers from Martin, the present generator concept is regarded as a reference design for a flight version which Martin would probably be asked to build if NASA and the Atomic Energy Commission approve the use of a radioactive-fueled generator for Surveyor. The Surveyor program directors are believed to favor a generator of this type over a more conventional solar cell and storage battery power supply for technical reasons. But their choice could be finally overruled by the political authorities whose approval had to be secured before the Navy was able to attempt to orbit a smaller, 2.7 watt, Martin-made plutonium 238 radioisotope generator now successfully powering its Transit 4A satellite.

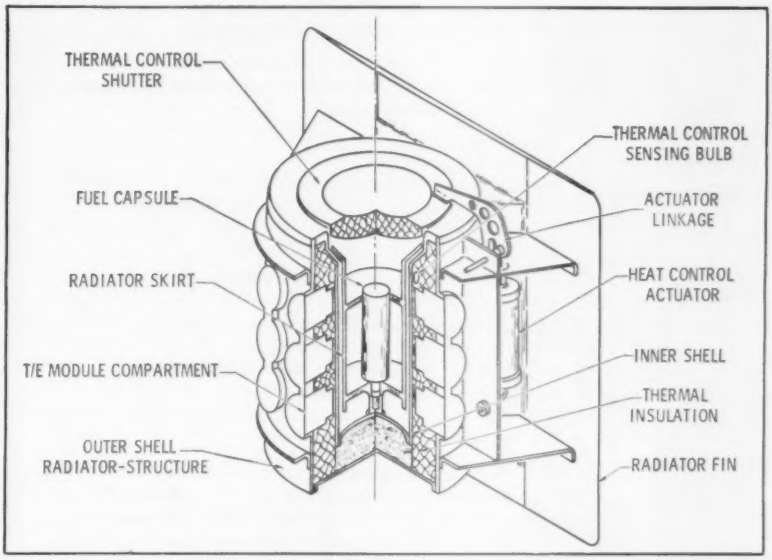
Elsewhere at this meeting, it was reported that the State Department had not received the unfavorable foreign reaction it feared to the orbiting of a radioactive device in space. On the other hand, landing a radioisotope generator on the moon, some scientists say, presents a possibility, no matter how remote or how thorough the precautionary measures, of interfering through undesired or excessive contamination with scientific exploration of the moon.

Curium 242, which is obtained by neutron irradiation of americium 241, was selected for a variety of reasons, explains Alan J. Streb, who presented the joint report prepared by him, Robert J. Wilson and Thomas S. Bustard. The isotope and its daughter, plutonium 238, are primarily alpha emitters and would not add to the moon a constituent that was already there. Since these are essentially artificial elements their presence on the moon could be discounted in future scientific investigations.

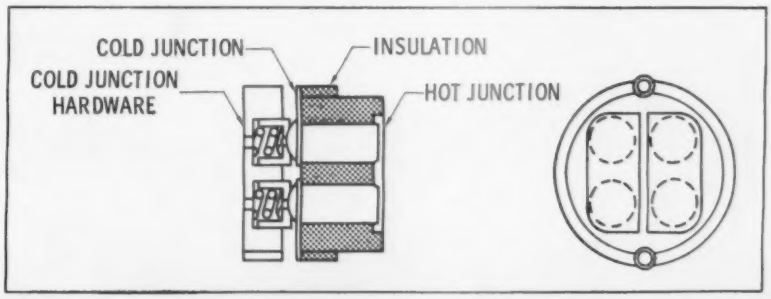
The entire generator, including shielding, would weigh about 30 lb. and could provide about 18 watts during the lunar day, an output that would rise to about 25 watts during the lunar nights because the cold junction temperatures of the thermocouples would be lower than during daytime. The generator was designed primarily for nighttime operation.

Ability of the radioisotope generator to operate during the 14-earth day lunar nights is one of its principal advantages over a solar cell system which would have to convert sufficient solar energy while facing the sun to charge batteries for lunar nighttime operation.

Another prime advantage is its supplementary use as a thermal electronic control. Waste heat of the radioisotope generator can be radiated into the electronics package of Surveyor instruments



RADIOISOTOPE THERMOELECTRIC GENERATOR, designed to provide up to 25 watts of electrical power for instruments and electronic gear on the Surveyor soft-landed lunar vehicle, employs fuel capsule containing a small amount of curium 242 as a heat source for two parallel banks of lead telluride thermocouples. Generator would weigh about 30 lb., and will form the 8-in. dia., 9-in. long cylindrical unit diagramed above, which, attached to a 13 by 13 in. radiator fin, could provide heat for sensitive electronics equipment during the long lunar nighttime periods. Thermoelectric modules of the Surveyor generator (below) contain two pairs of thermoelements with hot and cold ends prebonded to iron shoes. The two pairs in a disk of insulation make up the module. During the lunar night, when the cold junctions are at lower temperatures than during the day, the unit would produce 25 watts compared with 18 during the day.



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to protect them from the cold lunar extremes (lunar nighttime temperatures range down to roughly −245F).

Heat flux radiated into the electronics package will be controlled by a thermal shutter or series of louvers positioned according to the temperature of the package, Streb says. At night, the package required about 100 thermal watts while during the day this requirement vanishes and the control is closed to block radiant transfer.

The generator itself is cylindrical in shape, roughly nine inches long and eight inches in diameter, and contains within it a smaller container with curium 242. The cylinder is attached by tapered fins to a 13 in. square radiating surface to be used for temperature control.

Heat produced in the radioisotope capsule flows through the heat source assembly in which it is centered and is radiated to the inner shell, according to Streb. Heat then is conducted through the thermoelements and insulation to the outer generator surface which radiates it into space. Electrical power is produced by the Seebeck effect as the heat flows through the thermocouples.

To offset a possible dropoff in power output from the device as the isotope's heat production decays over its 120 day lifetime, the isotope inventory is deliberately oversized, Streb explains, and the excess heat discarded by a high-temperature radiator over the first days of its life. The rate at which heat is dumped throughout generator life, he adds, is controlled by positioning a shutter door covering the high temperature radiator in accordance with temperature of the thermoelement's hot junction.

The surface of the generator, not including the shutter, is coated with a high temperature oxide with high emissivity in the infrared and a low absorptivity with respect to solar radiation.

An oxide with the combination of these two characteristics, the authors of the report say, permits a high efficiency, minimum sized radiator to be realized.

In nighttime operation, over-all efficiency of the generator is expected to be 4.65% while the efficiency of the thermoelectric conversion will be at least 5.55% and 4.8% during the day. Minimum heat input to the thermoelements is 450 watts. Another 87.5 watts would be consumed as miscellaneous losses. Figuring a total heat requirement of 537.5 watts nocturnal operation and about 25 watts output gives over-all system efficiency of 4.65%. Maximum load potential is 3.27 volts. The 25 watts available should be sufficient for Surveyor instruments (AW July 3, p. 62) provided

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Flight Propulsion

McDonnell F4H Breaks World 3-km Speed Mark

WHITE SANDS, N. M. — The U.S. Navy's McDonnell F4H Phantom II collected its fourth major flight record here when it smashed the world three kilometer speed mark.

Flying below an altitude of 100 kilometers (328 feet), the G-E J79-powered fighter streaked across the 1.8 mile course at an average of 902.768 miles an hour. It surpassed the previous record, set by a USN Douglas XF4D in 1953, by nearly 150 mph.

The McDonnell F4H made its debut as a world recordholder roughly a year ago when it broke two Russian-held closed course speed marks. In early September, 1960, the F4H circuited a 500-kilometer closed course at 1216.78 mph. A few weeks later it logged 1390.21 over a 100-km closed course.

Navy F4H flies low during record 3-km run

J79 DOMINATES SPEED RECORDS

CINCINNATI, Ohio—Of the nine world speed records over 1000 miles-per-hour currently recognized by the Federation Aeronautique Internationale, eight are accredited to U.S. aircraft powered by the General Electric J79 engine.

Three fourths of them are held by the USAF Convair B-58 Hustler, which racked up six records last January over 1000- and 2000-kilometer closed courses. Top speed logged by the Hustler was 1284 mph.

The remaining two speed marks —a 100-km closed course speed record of 1390 mph, and a 500-km closed course record of 1216 mph—are held by the Navy's McDonnell F4H Phantom II.

These two aircraft, together with the G.E.-powered Navy North American A3J and Air Force Lockheed F-104, now hold 19 of the 42 world jet aircraft altitude, speed, and time-to-climb records recognized by the FAI.

G.E.-powered Piaggio-Douglas executive jet is slated for flight test in late 1962.

CJ610 Engine Chosen for New PD-808 Jet

LYNN, Mass.—Twin General Electric CJ610 turbojet engines have been selected to power the new Piaggio-Douglas PD-808 executive jet aircraft.

The PD-808 marks the third executive-jet application of the CJ610 to be announced this year.

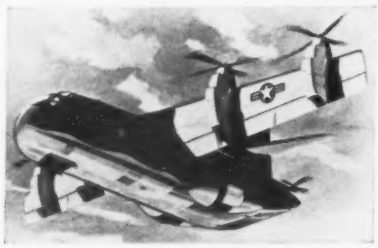
The new jet, designed by Douglas Aircraft Company and to be built by Piaggio Company of Italy, is scheduled for flight test late next year. Intended primarily as a seven-place craft, it may also be equipped as a high density, 10-place transport, or as a deluxe six-place executive plane.

Under arrangement with Piaggio, Douglas plans to sell and service the 500-mph aircraft throughout most of the world starting in 1963.

The CJ610-1 engine selected for the PD-808 develops 2850 pounds of thrust. Only 40 inches long and weighing 355 pounds, it produces more power for its size and weight than any other aircraft powerplant available today. Another version, the CJ610-2B, produces 2400 pounds of thrust.

Both models of the CJ610 will be FAA certificated this year. It is already in high volume production as the military J85 turbojet, which powers the Air Force's Northrop T-38 supersonic trainer, the Northrop N-156 Freedom Fighter, the McDonnell GAM-72 decoy missile, Radioplane's Q-4B supersonic target drone, and the NASA X-14A VTOL demonstrator.

High performance of the CJ610-1 permits twin jet business aircraft such as the PD-808 to take-off and land on the same fields as those used by prop-driven aircraft.



T64 Turbines to Power Tri-Service Transport

LYNN, Mass.—The Tri-service VTOL transport, to be built by the team of Ling-Temco-Vought, Ryan Aeronautical Co., and Hiller Aircraft Corp., will be powered by General Electric T64 gas turbine engines.

The new aircraft is intended for rapid all-weather transport of combat troops, equipment, and supplies from assault ships or airfields into unprepared areas.

Four G-E T64-6 engines, mounted on a tilting wing, will drive four conventional 15-foot propellers and a horizontally mounted tail rotor through an interconnecting gear train and shaft.

The aircraft will have a cruising speed of 250-300 knots, with a top speed of 400 knots at sea level. Its combat radius, while carrying 32 fully equipped combat troops or equivalent, will be from 200 to 300 nautical miles. Fitted with auxiliary fuel tanks, it will have a ferry range of up to 2600 nautical miles without cargo.

NEWS

A report about progress in research and products from the Flight Propulsion Division of the General Electric Company

TWA Orders 20 G-E Aft-turbofan powered Caravelles

TWA markings will identify the new aft-turbofan powered Caravelle 10A when 20 of the advanced medium-range jetliners start domestic service beginning in 1963.

NEW YORK, N. Y.—Twenty Sud/Douglas Caravelle jetliners have been ordered by Trans World Airlines for service starting in early 1963, it was announced recently by TWA president Charles C. Tillinghast. The 20-aircraft order also included an option for 15 more of the same type.

To be known as "La Nouvelle Caravelle," the model 10A aircraft selected by TWA has modifications that make it the fastest, most advanced of the famed Sud Caravelle series.

Power for the new Caravelle will come from two General Electric CJ-805-23C's—aft-turbofan powerplants that will provide the jetliner with better efficiency, lower noise levels, and increased climb and cruise thrust.

First delivery of the TWA Caravelle fleet is scheduled for January of 1963, with completion of the initial 20 by July.

Airframe modifications on "La Nouvelle Caravelle" include an increase in passenger capacity (68 first class seats as opposed to 64; ranging to 85 tourist seats), and wing configuration changes that permit greater speed capabilities.

Sud Aviation's aerodynamic changes, combined with G-E aft-turbofan engines, will give the Caravelle 10A improvements in both range and speed.

Increased climb thrust of the aft-turbofan engines will enable the Caravelles to reach an altitude of 30,000 feet in 18 minutes at full gross weight.

The new Caravelles at an average TWA trip distance will operate from 5000-foot runways, which will enable TWA to offer jet service over a greater portion of its route structure. Operating range will be about 1400 miles, and top cruising speed around 560 miles an hour.

Intensive flight test experience has already demonstrated performance of the CJ-805-23C engine. During a recent European demonstration tour of the G-E Caravelle, there were no delays or cancellations in 64 scheduled departures from 16 airports in 11 countries.

T64-powered Caribou Makes 1st Flight

DOWNSVIEW, Ontario—Flight testing of General Electric's T64 turboprop engine began here on September 22 aboard a deHavilland DHC-4 Caribou flying test bed.

The current program's in-flight testing of the Caribou with T64-4 engines is scheduled for completion early next year.

The T64's maiden flight at deHavilland's Downsview plant lasted more than an hour. Altitudes ranged between 4000 and 12,000 feet.

The flight test program is being conducted by General Electric and deHavilland under sponsorship of the U.S. Navy, for whom the engine is being developed, and with the cooperation of the Canadian Department of Defense Production and the RCAF.

The T64 engine, designed for a variety of applications including V/STOL, helicopter and conventional aircraft, is the first American gas turbine that approaches the low fuel consumption of a reciprocating engine. It can be operated continuously at angles from 100 degrees nose up to 45 degress nose down, and has four configurations—two turboprop, a turboshaft, and a direct drive version.

Development of the T64 began in 1957. Up to the start of the current flight test program the engine had accumulated more than 8000 hours of development test time.

The conventional piston-powered Caribou, an STOL troop and cargo transport capable of operating from rugged battlefront areas, is currently in service with the U.S. Army, the Royal Canadian Air Force, Free World forces and the United Nations.

Caribou climbs in first T64 test flight

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GENERAL ELECTRIC

12 Rescued From Burning Plane Before 100,000 Spectators

THREE PERSONS WERE KILLED, 12 others injured, when this Air Force transport crashed during a recent air show at Wilmington. The Kaman H-43B helicopter, left, maintained its position so that the helicopter downwash could blow the flames away from the cabin. Officials said the helicopter assisted rescue operations and helped save more serious injuries to the passengers. At right, military personnel and civilians man a fire-fighting truck.
Photo By — Phil Morgan WECT-TV

QUICK THINKING AND COURAGE OF OFF-DUTY HUSKIE RESCUE TEAM PREVENTS FURTHER TRAGEDY

WILMINGTON, N. C. — The dramatic rescue of 12 men from a burning C-123 transport which crashed before 100,000 horrified spectators at an air show in Wilmington, N. C., Sept. 24, 1961, has been credited to the courage and skill of an H-43B HUSKIE crash-rescue helicopter crew trained in Air Force fire-rescue techniques. Newsmen in Wilmington and Air Force firemen, working in the flaming wreckage, have said the effectiveness of downwash from the rotors of the hovering helicopter made it possible for rescue workers to toil for as long as 15 minutes freeing trapped passengers.

The Kaman H-43B HUSKIE from Seymour-Johnson Air Force Base, N. C., was assigned to the air show for a static display. It was not on duty for crash emergencies. Crew of the Helicopter was Capt. J. C. "Jack" Armstrong, Jr., pilot; 1Lt. Charles Morrill, co-pilot; SSgt. Donald H. Holloman and A1C Gene Mayo, both crash rescue specialists, and Capt. Charles Pummill, flight surgeon.

When the crash occurred, the H-43B crew was sitting outside their aircraft watching the show. Within two minutes the crew had pushed the helicopter out of the display area and were air-borne on the way to the crash scene. Capt. Armstrong hovered the helicopter over the nose of the burning aircraft, blasting rotor downwash through broken cockpit windows. Firemen were able to enter the stricken plane. They reported that the helicopter downwash was funnelling through the length of the fuselage, keeping it clear of smoke, fumes, heat and flames.

Rescue personnel worked for 10 minutes freeing victims trapped in the cockpit and for as long as 15 minutes in the mid-section of the plane extricating an Army sky-diver who had been pinned by wreckage.

At one point in the 20 minute drama, Capt. Armstrong landed his helicopter to discharge the rescue men and flight surgeon. In that brief moment smoke billowed through the stricken plane, overcoming a fireman working in the rear of the fuselage. Moments later the helicopter was air-borne, once again driving volumes of fresh air through the crash wreckage.

The fireman who was momentarily overcome reported he could feel the blast of clean air sweep the fuselage free of choking smoke and heat. The fireman was hospitalized briefly after his experience.

The H-43B evacuated three critically injured survivors to the hospital when its fire suppression job was complete. During the trip a civilian doctor performed a tracheotomy on one patient who was unable to breathe. The operation was performed in-flight with the doctor using a crewman's survival knife.

At the hospital Capt. Armstrong made a vertical descent down the side of the tall hospital building, rotors clearing the building by six to eight feet. He landed the helicopter on one half of a tennis court.

Firemen from Seymour-Johnson Air Force Base manning a fire truck loaned for the air show, played a major part in suppressing flames at the rear of the crashed C-123 and working ceaselessly inside the aircraft freeing trapped personnel.

Nearly 100 HUSKIES are on duty with Air Rescue Service, MATS, at Air Force bases throughout the nation. Air Rescue Service is responsible for the Air Force local base rescue mission, a mission which is designed to meet this type of emergency.

KAMAN salutes the Air Force and its crash-rescue teams who are **always** on the alert to protect the men who are protecting our country.

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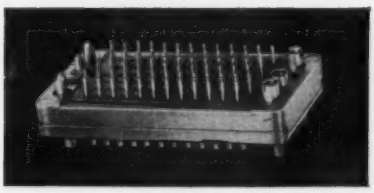

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experiments and communications are sequentially rather than simultaneously operated.

If the generator were to be built today, it would use lead telluride thermoelements which are among the best semiconductors available for thermoelectric power conversion. The Surveyor generator design employs 35 couples in two parallel banks with hot junctions around the heat source. Each bank can produce 12.5 watts. P and N elements will each be ¼ in. long with diameters of 0.363 and 0.333 in. respectively. Streb says that experiments were conducted which indicated gamma radiation had no effect upon the thermoelements, but effects of solar protons were not investigated.

Both thermocouple banks will operate simultaneously to supply a load and to prevent adverse temperature gradients in the generator, Streb says.

Thermoelements are prebonded at both hot and cold junctions to iron shoes and two bonded pairs are placed in a disk of insulation to make up a thermoelement module.

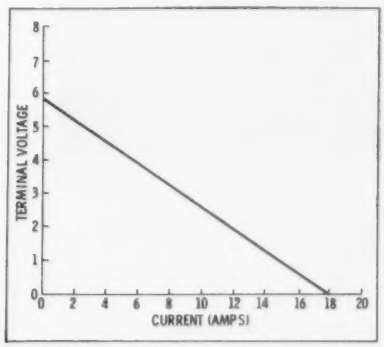
Generator Advantages

Advantages cited for a radioisotope generator include:

• **Reliability**—Redundant design of subsystems within the generator and the absence of moving parts within the conversion system (thermocouples) are expected to combine to give high overall reliability.

• **Nocturnal power**—System provides power at relatively high efficiency during nighttime periods when it has distinct advantages over a solar cell system which needs to be properly oriented toward the sun and which needs storage batteries to supply power during night.

• **Insensitivity to lunar environment**—Radioisotope system is relatively insensitive to sharp day-to-night changes in lunar environment without output changing too appreciably. Since the radioisotope system is optimized for nocturnal operation it might be supplemented by a solar cell panel for additional daytime power.



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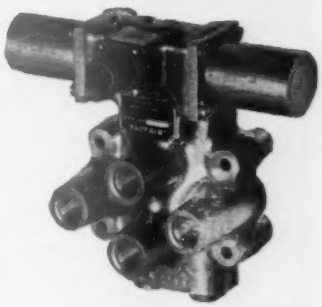

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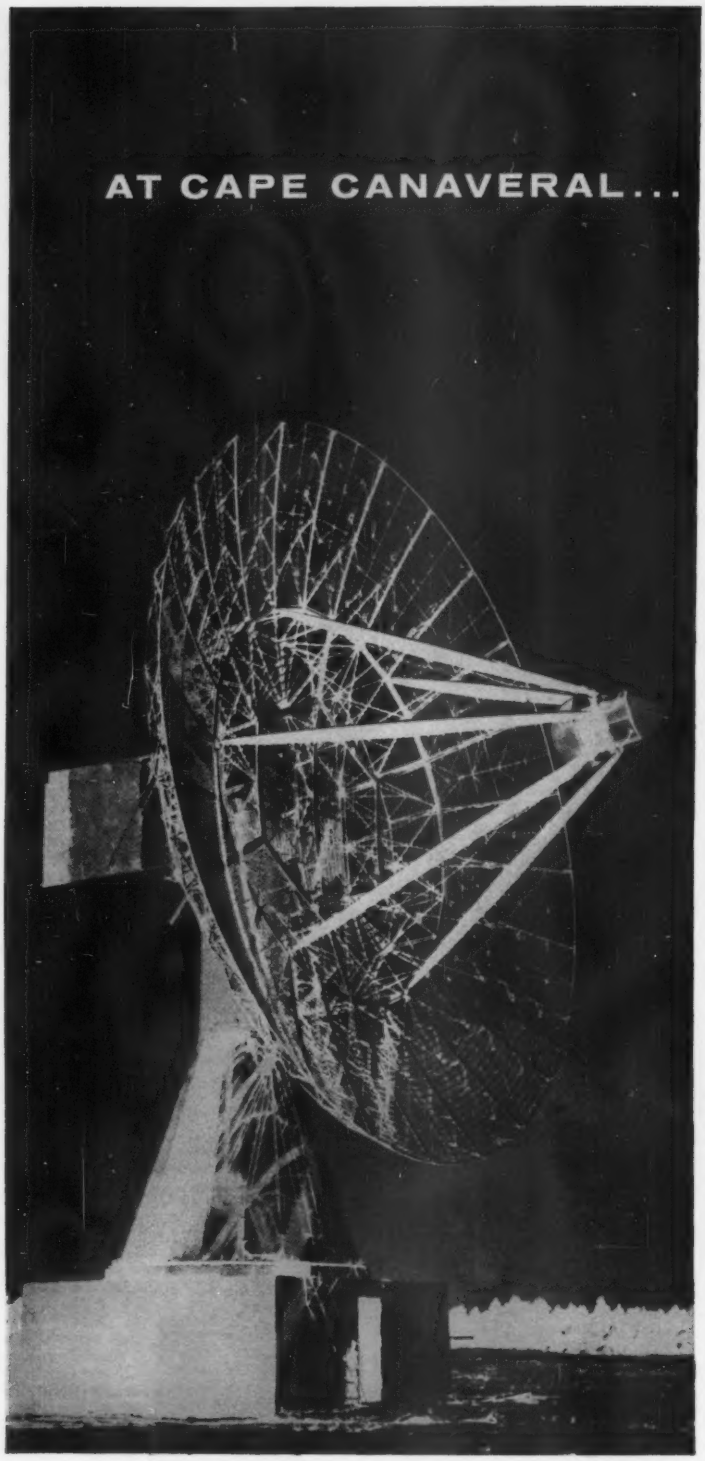

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P MINE TO MARKET D

Advances in Avionic Devices Reported

By Philip J. Klass

Washington—Advances in semiconductor devices, micro-electronics, power tubes, switching and display devices were reported here during the recent Annual Electron Devices Meeting, sponsored by the Institute of Radio Engineers.

• **Microwave transistors,** capable of operating at frequencies above 2,000 mc., were reported by Fairchild Semiconductor Corp. and Bell Telephone Laboratories scientists. Fairchild's double-diffused silicon planar N-P-N transistors have exhibited gains as high as 14 db. at 2 kmc. and have oscillated at 2.4 kmc., with oscillator output powers of 40 milliwatts obtained at 1 kmc. (The report was jointly authored by D. F. Allison, Oscar Baker and G. E. Moore.) Bell Telephone Laboratories' J. T. Nelson and A. G. Foyt reported performance of a single transistor amplifier, using a diffused-base germanium device, which provided 12 db. gain at a center frequency of 1.9 kmc. with a 3 db. bandwidth of 200 mc.

• **Tunable semiconductor** high-Q inductor, using a germanium transistor whose inductance can be varied by changing its base resistance and collector capacitance, has been demonstrated by Hughes Aircraft scientists. Technique is expected to prove useful in micro-electronic semiconductor circuitry. Inductances ranging from a few millihenries at frequency of several hundred kilocycles to 1 henry at 100 cps. have been obtained, it was reported. The report was jointly authored by Charles Fa, Hans Dill and Warren Waters.

• **Tunable semiconductor delay line** in which the delay increment can be varied by changing the voltage applied to the device, was reported by John S. Winslow of Electro-Optical Systems, Inc. The delay line consists of a germanium bar, approximately 0.1 x 0.1 x 1.0 cm. long which is tapped and each tap feeds a resistive summing network. Electric field is obtained by means of voltage applied across ohmic contacts at each end of the bar. In operation, a periodic signal applied to the device whose period is equal to the delay increment between taps produces a maximum signal output from the summing network, while signals at other frequencies are not amplified as much. In a typical unit, center frequency can be changed from 15 kc. to 30 kc. by changing applied voltage from 10 to 20 volts. Pass bandwidth is one-third of center frequency and power gain is greater than unit, Winslow said.

• **Semiconductor impedance** transformer, a new type device fabricated on a single silicon crystal which can be used to transform from high to low impedance levels with power gains of 40-50 db. over a limited frequency range, was reported by Karl Yu and Larry Pollock of Westinghouse Electric. Present design provides over-all transconductance of 5,000 to 10,000 mhos and open circuit voltage gains greater than 20.

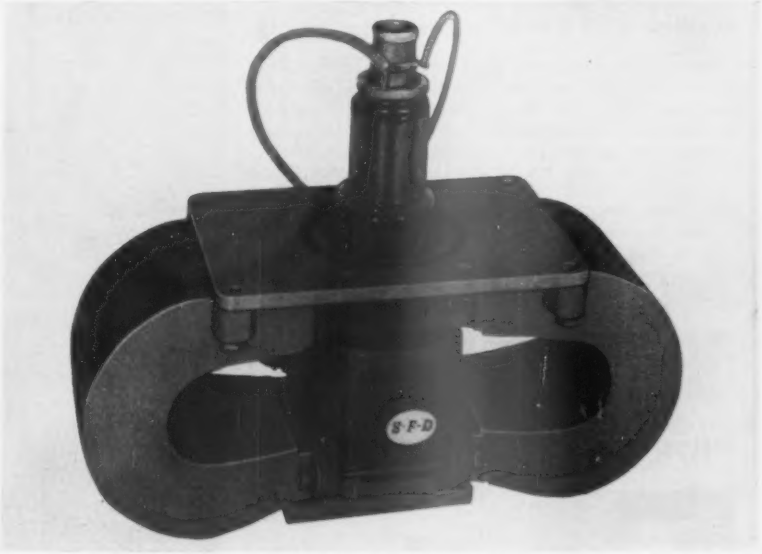
• **Radiation-resistant solar cells** fabricated from gallium arsenide, which have exhibited conversion efficiencies up to 13%, were reported by N. F. Lamorte of Radio Corporation of America. This is the highest conversion efficiency yet reported for gallium arsenide and makes it directly competitive with silicon. The report was authored with D. P. Bortfeld, A. R. Gobat and G. W. McIver. Bell Telephone Laboratory scientists reported the development of N-P type silicon solar cells with N+ diffusion layer thickness of ¼ to ½ micron, making them radiation resistant and sensitive to solar energy in the 0.4 to 0.7 micron region. Although the new N-P cell has lower initial conversion efficiency than a conventional P-N cell, it can deliver far more power than a conventional cell after both have been subjected to radiation, BTL scientists reported. The report was jointly authored by K. D. Smith, W. G. Ansley, D. F. Ciccolella and M. P. Lepselter.

Developments in power tubes reported at the Annual Electron Devices Meeting included the following:

• **Crossed-field amplifier,** a new type of forward-wave amplifier with non-re-entrant beam and wave, called the Dematron, which has demonstrated pulsed power output of 500 kw. at X-band, 13 db. gain, 15% bandwidth and 35% efficiency, was reported by Litton Industries engineers. (G. E. Pokorny, Alan E. Kushnick, and Joseph F. Hull.) New tube is the first to exhibit gains above 6 db. in a distributed emission crossed-field amplifier without using regenerative feed-back of a re-entrant electron beam, permitting far greater usable bandwidth, the authors said.

• **Small traveling wave tubes,** developed for use in communication satellites and other space vehicle communication applications, were reported by three companies. Sperry Gyroscope's Jerome Herman described a traveling wave tube for operation at frequency of 5 to 12 kmc., with continuous-wave output of 10 to 40 watts, which weighs only one pound including focusing magnet. A report by J. N. Nelson and L. A. Roberts of Watkins-Johnson Co., described a traveling wave tube with power output above 12 watts in the 2.0 to 2.4 kmc. band. Tube has over-all efficiency including heater power of 27% at band center and provides more than 30-db. saturation gain. Weight of encapsulated tube, including focusing permanent magnet, is 1½ lb. Bell Telephone Laboratories' M. G. Bodmer described a traveling wave tube designed to operate for more than 10 years, with over-all efficiency of 31% and a ruggedized heater that consumes about 1½ watts.

• **High-power traveling wave tube,** a



SUPER-POWER X-band magnetron, developed by S-F-D Laboratories, delivers 1½ megawatts peak power, 750 watts average, with very high frequency stability. Tunable version of new magnetron with one megawatt output is under development.

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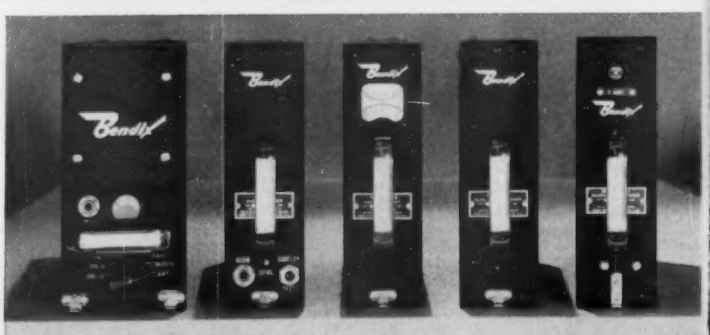


HIGH-POWER TWT delivers 1 megawatt over frequency range of 2.55 to 3.45 kmc. with 30% bandwidth at 3 kmc. Tube, developed by Sperry, is called "Meanderline" because of coiled tube which conducts input signal and carries liquid coolant. Tube, shown in two sections, is 4 ft. long.

periodic traveling wave amplifier capable of producing up to 500-kw. peak power output at S-band, with a small signal gain of 32 to 40 db. and a saturated gain of 26 db. over the bandwidth of 2.85 to 3.2 kmc., was described in a report by B. A. Highstrete and A. L. Rousseau of Hughes Aircraft's Microwave Tube Division. Weight of the tube, including permanent focusing magnet, is 90 lb. and its over-all length is 31 in.

• **High-power L-band klystron,** a four-cavity tube which produces more than five megawatts peak and 300 kilowatts average power for pulse lengths of more than 500 microseconds, was reported by R. E. Holaday and G. W. Petersen of Litton Industries. Tube operates over a 10% tunable bandwidth with power gain in excess of 40 db. Tube has phase linearity characteristics which permit use of limited pulse compression.

• **Ultra-high-power X-band magnetron;** new type known as the CEM Coaxial Magnetron, which has delivered 1½ megawatts peak power, 750 watts average, and weighs only 45 lb., making it suitable for long-range airborne radar, was reported by Fred Feulner of S-F-D Laboratories, Union, N. J. (Report was jointly authored by Jerome Drexler and Alfred Cook). Feulner said the frequency stability of the new type magnetron is four times better than conventional types. A tunable version of the CEM magnetron, now under development, has generated a minimum of one megawatt peak power when tuned between 8.5 and 9.3 kmc., it was reported, with no discontinuities throughout the range. Even wider tuning range is expected.

• **Ultra-high-power** traveling wave tube, which produces one megawatt output over a 30% bandwidth at S-band, using broadband open interaction structure called a ring-loaded Meanderline, was described by Carl Burklund of Sperry Gyroscope Co. Tube is tunable between 2.55 and 3.45 kmc., producing 1.25 megawatts at center frequency, with efficiency of 30%. Basic design is expected to permit outputs of several megawatts. A coiled tubing performs dual function of conducting input signal and carrying coolant liquid.

Display and Switching

Developments in display and switching techniques reported at the Annual Electron Devices Meeting included the following:

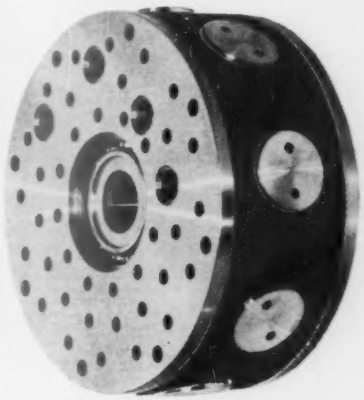
• **High density cathode ray tube,** with electron gun capable of producing a spot with a diameter of only eight microns, equivalent to a display of 92 million dots on a 5-in. tube face, was reported by Dr. Kurt Schlesinger of General Electric Co., Syracuse, N.Y. The microspot tube can scan a square of 8 cm. in 9,600 lines using 42 deg. magnetic deflection. Tube has application to high-resolution radar displays and to GE's thermoplastic recording technique. With spot size this small, a conventional television picture could be compressed to an area measuring only ¼ x ⅜ in., without loss of resolution, Schlesinger said. Tube uses a thin-film, grainless vapor-deposited phosphor screen.

• **Electron beam diode switch,** a high-speed, high current driver for switching computer core memories, using a matrix of back-biased P-N junction diodes which are irradiated individually by an electron beam, was described by Dr. A. V. Brown of International Business Machines Corp. Research Center. The diodes are conventional except that junction is produced at a distance of only six microns below the surface. When electron beam strikes individual diode, it releases thousands of electron-hole pairs, giving an extremely short switching time of the order of 5 to 50 nanoseconds.

• **Field-effect cryogenic switch,** new three-terminal low-temperature semiconductor device, called Cryosistor, for use in high-speed computer memory

MINIATURE traveling wave tube for space communications. Type STX-186, delivers 10 watts CW at frequencies of 5 to 12 kmc. with gain of 40 db. Tube, now in pilot production at Sperry Electronic Tube Division, weighs 1 lb., measures 9 in. long.

In another week this motor will complete one revolution



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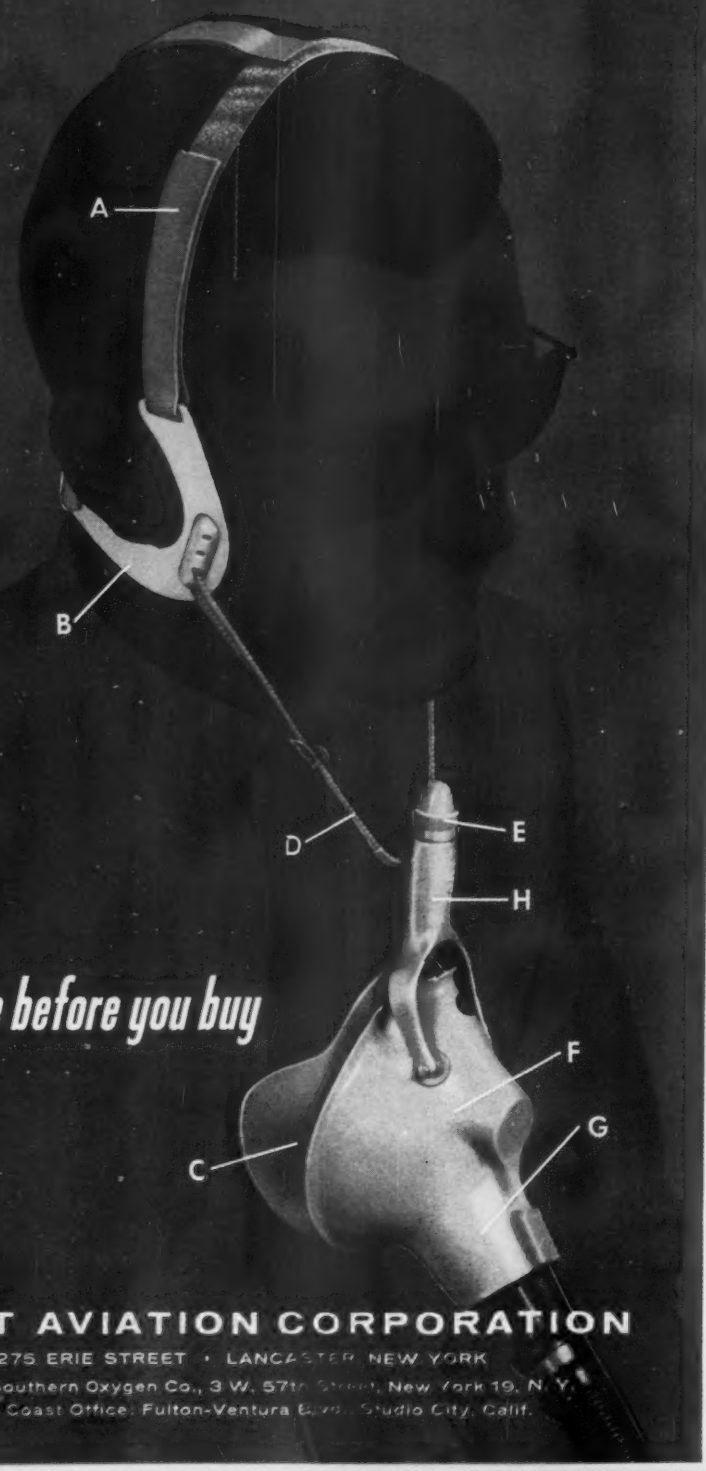

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Midas Automatic Checkout System Detailed

Los Angeles—Lockheed Missiles and Space Division briefed a wide variety of computer, checkout equipment and other aerospace companies about plans for a completely automatic checkout system for the Midas missile warning system at a series of pre-program briefings held in Van Nuys, Calif. late last month.

Lockheed, prime contractor for the missile warning satellite system, does not now hold a contract for an automatic checkout system for Midas but expressed its hope of obtaining one soon. This hope is reported to be based on a several-month old statement of an Air Force requirement for an automatic checkout system for Midas ground facilities and possibly for the vehicle too.

Both Lockheed and Philco, associate contractor for tracking facilities, and several other companies have separately proposed such systems to the Air Force in recent weeks. The Air Force does not have funds specifically designated for this, but presumably they can be made available from other allocations.

Lockheed asked aerospace support equipment makers at the recent briefings to prepare rush proposals to assist the space-frame manufacturer in presenting concise cost estimates to the Air Force. If Lockheed then gets the go-ahead on the automatic system from USAF, or wins a possible open competition for the system if USAF decides to put it out on bid, the space-frame manufacturer would place the five parts of the system up for industry competition. Companies attending the briefings in Van Nuys were asked to submit their proposals by early this month.

Lockheed told interested companies that it does not believe any single organization can handle the entire checkout system job. It has, therefore, split the system into five parts and asked industry to bid on one or more individual parts. These are:

- Large digital computer.
- Support equipment including jacks and dollies.
- RF equipment.
- Cabling and power supplies.
- Simulator to simulate Midas launch.

Integration of the five parts into a complete system and ironing out any interface problems which may arise is the task Lockheed has assigned to itself.

Companies which attended the briefings include Astro Data, Autonetics, Aeronutronic, Airborne Instruments Laboratory, Astral Electronics, Assembly Engineers, Automation Development Corp., American Electronics, Arnoux Corp., Burroughs, Bendix, Consolidated Systems, Control Data Corp., Dunn Engineering, Electronic Engineering and Emerson Electric.

Also, Food Machinery Corp., General Electric, General Mills, General Dynamics/Electronics, Minneapolis-Honeywell, Hughes Aircraft, Hallamore Electronics, International Business Machines, Litton, Ling-Temco-Vought, Missile Space Systems Engineering, Moxon Electronics, Robert S. Miller Co., Packard Bell, Philco, Ralph M. Parsons, Ramo-Wooldridge, Radio Corp. of America, Remanco, Solar Aircraft, Tredea Electronics, Remington Rand Univac, Video Corp., Weber Aircraft and Westinghouse.

and logic circuits as well as in pulse amplifiers and trigger circuits, was described by Ivars Melngailis of Lincoln Laboratory. At temperature of liquid helium (4.2K), impact ionization breakdown occurs in compensated germanium at a critical electric field value with an abrupt decrease of electric resistance. Impact ionization between the Cryosistor's two ohmic contacts is controlled by reversed bias rectifying junction located between two contacts. Short voltage pulses produce switching times as short as a few nanoseconds, according to Melngailis.

• **Ten-channel switching tube,** a cathode ray type device with five stages of multiplication which provides low cross-talk between channels, low beam potential and is light in weight, was reported by Ralph Kalibjian, University of California Lawrence Radiation Laboratory. Tube was developed for use in converting wideband telemetry information on a single channel into 10 channels of narrow-band information, for transmission over standard telephone lines. Tube provides 20 milliamperes of output current with less than 5% cross talk.

• **High-power S-band switch,** capable of handling five megawatts peak power, with 20 db. isolation to the unused output and 0.5 db. insertion loss and with a switching time of a few radio-frequency cycles, was described by Ciro Milazzo of General Electric's Microwave Laboratory. Because discharge occurs in a high vacuum, there is no de-ionization time associated with the recovery from the discharge to the quenched state, according to GE's Milazzo.

• **Broadband, high-power switch,** a new type coaxial gas switch tube, using electronically controlled pulsed hydrogen arc discharge, which fires in a few tenths of a microsecond and recovers in about 10 microseconds, was reported by S. J. Tetenbaum, D. L. Campbell and R. R. Moats of Sylvania Electric Mountain View Laboratory. Switch covers frequency range from below 1 kmc. to above 4 kmc., operates over wide range of pulsed peak power, ranging from microwatts to hundreds of kilowatts. Unfired insertion loss is about 0.1 db., arc loss is 1 db. and leakage isolation exceeds 50 db.

FILTER CENTER

Lockheed-Marietta is evaluating bids from five autopilot manufacturers for flight control system to be used on new Air Force C-141 jet cargo plane and is scheduled to present its recommended choice to Air Force by mid-December. Five companies are Bendix, Collins Radio, Lear, Minneapolis-Honeywell and Sperry Gyroscope.

► **USAF Seeks Digital Pressure Transducers**—USAF's Aeronautical Systems Division is evaluating industry proposals in two digital transducer competitions, preparatory to awarding development contracts early next year. In the first competition, for which proposals were submitted last summer, ASD sought a digital pressure transducer—a device capable of providing digital outputs proportional to pressures sensed by the transducer without the use of conventional analog-to-digital techniques. In the second competition, proposals for a digital pressure transducer techniques program were due in Dayton last month. The latter proposal request asks for an investigation of a research model or models to demonstrate sensing and direct readout of minimum displacements due to pressure or acceleration. An award for the latter may be made by late winter. Neither contract is expected to exceed $100,000.

► **Coordinating Optical Maser Activity**—Ad hoc committee which will review research, development and engineering efforts on optical masers—both government and industry supported—was set up recently by the Office of the Director of Defense Research and Engineering. Robert H. Kingston of Lincoln Laboratory, Massachusetts Institute of Technology, is heading the group which is to determine which, if any, areas require greater efforts and possible support by the DOD office. The committee will function under the Advisory Group on Electron Devices (AGED).

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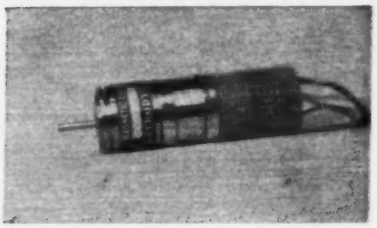

• **Clutched synchro,** an integral clutch, spring return mechanism and synchro all contained in Size 10 package. Return mechanism is set to ±1 min. of electrical zero of the synchro and repeats synchro position to within ±1 min. The synchro can be rotated through 360 deg. Manufacturer: Astrodyne Inc., 121 Clinton Rd., Caldwell, N. J.

• **Voltage-tunable magnetron,** Type ZM-6019, provides a minimum of 10 w. cw power across its frequency range of 2.5 to 3.5 kmc. The tube can be electronically swept through its entire operating band in less than 1 nanosecond. It is designed for use in receivers that employ an electronically swept oscillator, test equipment, drivers for amplifiers and S-band output tubes. In typical operations, anode voltage may be 2,000 v. at 3 kmc. Average anode current varies from 10 to 20 mils, filament current is 3 amp., filament voltage is about 2.5 v. Tuning rate is 1.5 mc. per volt. Tube package requires only input connections and RF power output connection, weighs 3.5 lb. Manufacturer: Power Tube Department, General Electric Co., Schenectady, N. Y.

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Both firms have pioneered the development of electronic power sources. The recent association of Behlman Engineering Company, a leading manufacturer of a-c power supplies, and Invar Electronics Corp., a producer of quality solid-state d-c power sources, now provides superior capability in both a-c and d-c equipment.

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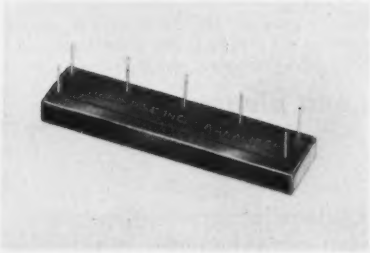
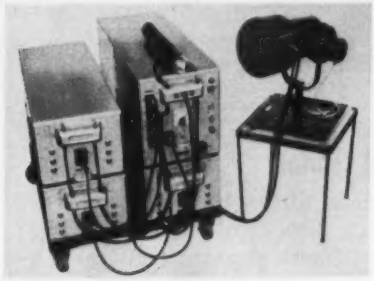
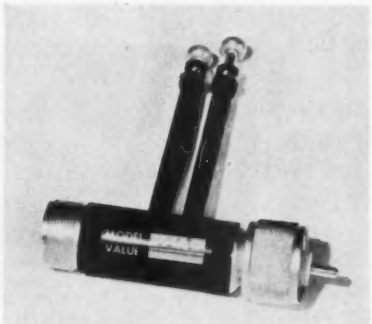


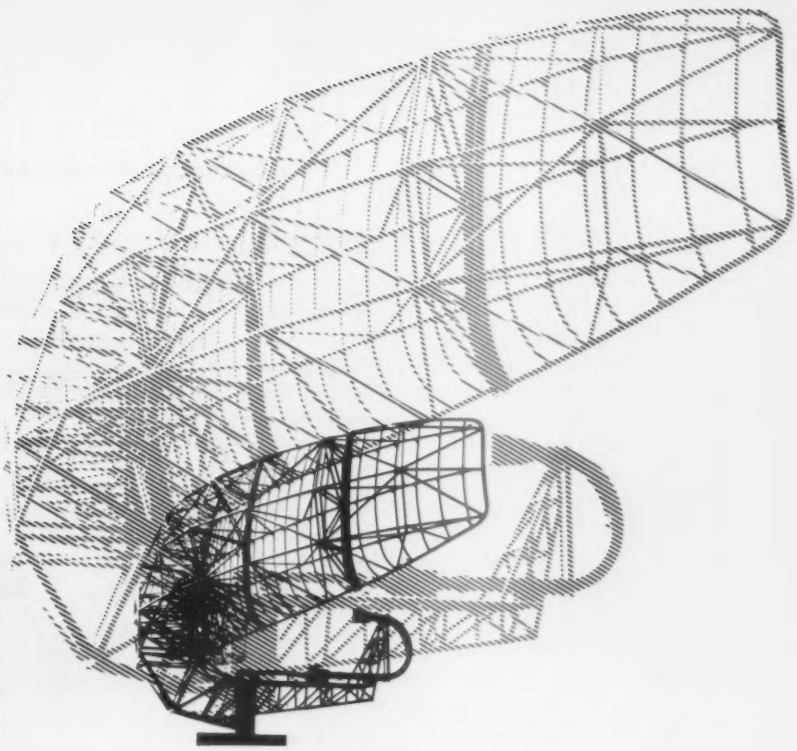
• **Delay lines,** designed for use with high-speed pulse circuitry, are available with time delays of 5 to 100 nanoseconds and are epoxy potted and suitable for mounting on printed circuit boards. Rise time for a 10 nanosecond unit is 9 nanoseconds. Bandwith for a 10 nanosecond unit is 100 mc. Manufacturer: Bel Fuse, Inc., 198 Van Vorst St., Jersey City, N. J.



• **Optical maser pump** power supply, Model 275, allows cycling rates of 2 sec. at 2,000 joules and 5 sec. at 4,000 joules for limited periods. The supply is intended to energize xenon-filled flash tubes with energy as high as 20,000 joules for pumping optical masers. Manufacturer: Electro Powerpacs, Inc., 5 Hadley St., Cambridge 40, Mass.



• **Coaxial tuner,** Model D-1142, a double stub tuner for use in 1,500 to 6,000 mc. range, employs LT connectors and tuner locking collets. Tuners are priced at $175 each and are available from stock. Manufacturer: Radar Design Corp., Pickard Dr., Syracuse 11, N. Y.



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Local airline service becomes new factor in marketing strategy

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Most local carriers schedule flights so frequently, convenient connections can easily be made among the major markets in their territories. Just recently, **Central Airlines** stepped up service to such major trading areas as Kansas City, Wichita, Salina and Topeka. **Pacific Air Lines** now provides over 100 flights daily between 31 cities in California, Oregon and Nevada. Current route systems of all domestic local airlines are available from the Association of Local Transport Airlines, Wyatt Bldg.,Washington, D. C.

NEW RADAR-CONVAIRS recently acquired by Central Airlines. 30% of all local plane miles are now flown by turbine or other newer-type equipment.

OSTRICH PLUMES and sequins for the stewardess are part of the Gay Nineties decor on Mohawk Airlines' popular "Gaslight Flights."

Extra services give local flying added economy and comfort

Outstanding customer service is a big reason why local airline passenger volume jumped a whopping 101% in less than 5 years. Now local carriers are going all out to make local flying more convenient . . . more pleasant and economical than ever before.

Allegheny Airlines, for example, lets passengers stamp their own boarding tickets on its no-reservation commuter flights—and slashes fares by as much as 40%. **Piedmont Airlines** lops nearly 75% off the return fare on some weekend flights.

On the lighter side, **Mohawk Airlines** offers passengers free cigars and an authentic Gay Nineties decor on its "Gaslight Flights" to the beautiful New York North Country. **Aloha Airlines** even puts on a floor show en route — as ukelele-playing, native-born stewardesses entertain passengers with singing and hula dancing.

Local carrier sets up vital air link with Glen Canyon Dam

Indicative of how local carriers expand to meet business needs in their areas is the **Bonanza** air service to the site of Glen Canyon Dam — one of the world's biggest building projects at Page, Arizona.

Daily **Bonanza Air Lines** jet prop flights connect Page with Phoenix and Salt Lake City. Personnel of the major contractors on the dam and government officials are the heaviest users of these flights. In addition, Bonanza flies in a variety of air cargo — ranging from medical supplies to construction gear.

GIANT NEW DAM at Glen Canyon will back the Colorado up for 185 miles. Scenic flights to the dam site at Page, Arizona, can be made on Bonanza Air Lines.

Information on how local airlines contribute to America's business growth . . . prepared by Texaco Inc., Aviation Sales Department, 135 East 42nd Street, New York 17, New York.

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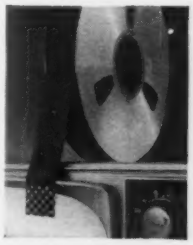
THE TAPE THAT CHANGED TV FOR ALL TIME

leads you right to rugged
SCOTCH® BRAND Heavy Duty Tape

THE TIE that binds television's top performer to instrumentation tape is strong—and it goes beyond the fact that the same expert team produces the best of both. "SCOTCH" BRAND Heavy Duty Tapes share a common heritage—and uncommon endurance—with "SCOTCH" BRAND Video Tape, the tape that puts a network TV show on the same "clock time" from Maine to California.

Similarities worth noting between the two: a similar high-temperature binder system, famous "SCOTCH" BRAND high potency oxides, a similar ability to resist tremendous speeds, pressures and temperatures while providing high resolution.

Let's look at the record of "SCOTCH" BRAND Video Tape and see what message it has for the user of instrumentation tape. On a standard reel of video tape like that shown here, some 1½ million pulses per second must be packed to the square inch—on a total surface area equal to the size of a tennis court. The tape must provide this kind of resolution while defeating the deteriorating effects of high speeds, pressure as high as 10,000 psi and temperatures up to 250°F.



The fact is that video tape must be essentially perfect. And it's a matter of record that thus far only the 3M experts have mastered the art of making commercial quantities of video tape that consistently meet the demands of the application.

Significantly, the high-temperature binder system developed for "SCOTCH" Video Tape is first cousin, only slightly removed, to that used in the Heavy Duty Tapes. It's this special feature that has given Heavy Duty Tapes their exceptional wear life.

The moral emerges: for tape that provides the best resolution of high and low frequencies under the severest conditions, turn to "SCOTCH" BRAND Heavy Duty Tapes 498 and 499.

They offer the high temperature binder system, plus the same high quality and uniformity that distinguish all "SCOTCH" BRAND Tapes. As the most experienced tape-makers in the field, 3M research and manufacturing experts offer tape of highest uniformity—from reel to reel and within the reel. Check into the other "SCOTCH" BRAND constructions: High Resolution Tapes 457, 458 and 459; High Output Tape 428; Sandwich Tapes 488 and 489; and Standard Tapes 403 and 408.

Your 3M Representative is close at hand in all major cities. For more information, consult him or write Magnetic Products Division, 3M Co., St. Paul 6, Minnesota.

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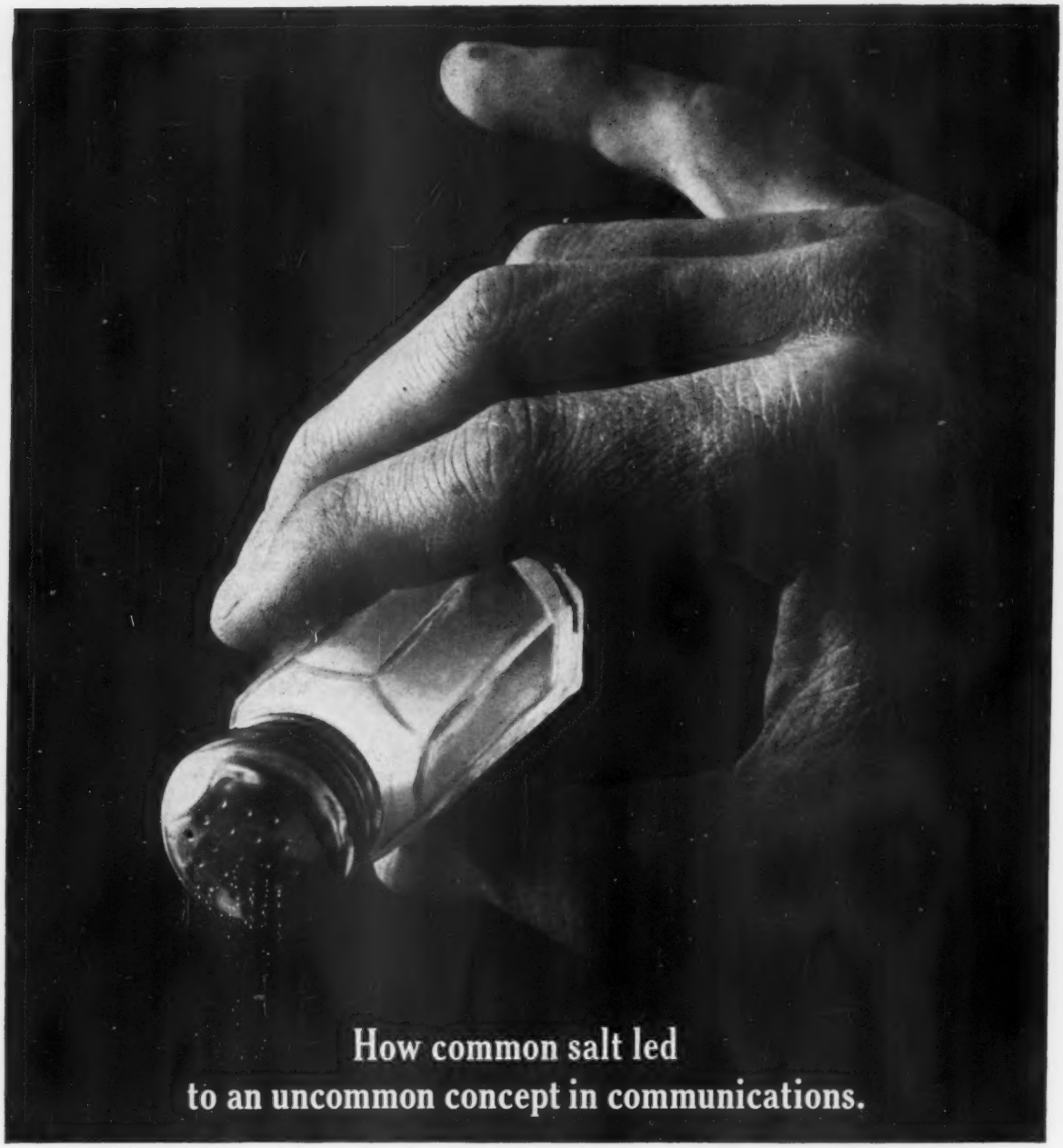
SCOTCH BRAND MAGNETIC TAPE

FOR INSTRUMENTATION

Magnetic Products Division 3M COMPANY



How common salt led to an uncommon concept in communications.

An unusual new device to increase radio reflectivity, now under development at Northrop's Radioplane Division, may well revolutionize the field of space communications. Called ADSAT (for Anomalous Dispersion Spherical Array Target), it should extend the usefulness of passive communications satellites out to 22,000 miles—the 24-hour orbit.

The germ of the ADSAT idea actually came from early X-ray diffraction experiments with ordinary salt crystals which yielded a pattern of intense bright and dark spots. This hint of resonance with the crystal lattice led Northrop researchers to attempt to duplicate this effect at radio frequencies—and the first version of ADSAT looked much like a molecular model, with silver-coated ping-pong balls serving as "atoms." The size of the balls and the intervals between them were carefully calculated to resonate with and reinforce the incoming frequencies.

In its present, basic form, the ADSAT satellite is a collapsible, spherical network, 100 to 400 feet across, with the resonant balls at each intersection of the network. It is designed to be launched in a small package, and inflated in orbit, much like Echo. The reflected signal, however, can be 1,000 times as strong as that obtained from a simple, Echo-type target of equal size.

The development of the ADSAT concept demonstrates once again Northrop's unique ability to visualize problems in space technology, decide what should be done, and come up with solid, workable answers.

NORTHROP

1962 MOONEY MARK 21C appears little changed from previous models, but features new propeller and hydraulic flap operation.

Mooney Plans New Models, More Dealers

Kerrville, Tex.—Mooney Aircraft outlined large-scale step-by-step plans for expansion in the light aircraft field during unveiling of the 1962 Mark 21C at the company's dealer-distributor meeting here.

Mooney President Hal Rachal outlined these steps to meet the goals set by Mooney management:

- **Capital expansion** is being undertaken to finance research and development on new airplanes, increased production of the current airplane and build-up of the sales organization.
- **Three different airplanes** are being planned now to add to the Mooney business aircraft model line within the next five years.
- **Expansion of sales outlets** will be speeded up to bring in more distributors and dealers at a faster rate than previously.

Although Rachal would not detail management's plans for capital expansion, he strongly indicated that company management was planning to bring in additional partners—individuals who would contribute management skills as well as substantial money. He noted that today's tax structure makes it exceedingly difficult for individuals, or a small group of men, to rapidly accumulate enough money to move fast when opportunities present themselves and the reference obviously was keyed to Mooney's present tightly held ownership.

Company recently absorbed its subsidiary, Mooney Aircraft Sales, to simplify its organization and prepare for financial expansion programs and also has started a program enabling employes to purchase shares.

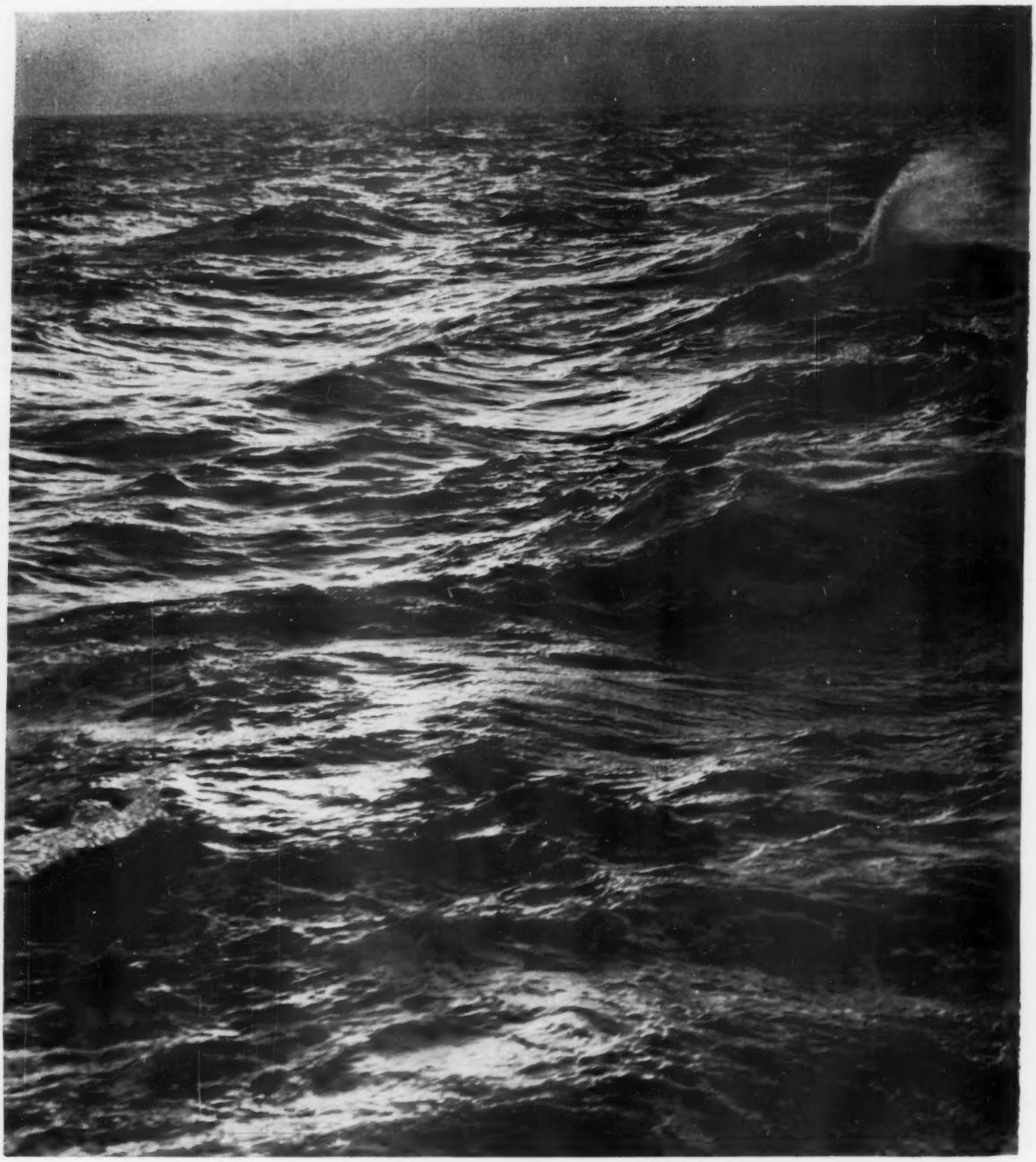
Rachal emphasized that the com-

Mooney Mark 21C Price List

Standard airplane (flyaway factory, Kerrville, Tex.)	$16,450*
Package A (standard airplane with Mooney full instrument)	$17,180
Plus Narco VHT-3 Superhomer	$17,775
Plus Narco VTR-2A Omnigator	$18,279
Plus Motorola M-135 (90/190 channels) plus omni	$18,990
Plus King KX-100 and KI-200	$19,047
Plus Narco Mark X and omni	$19,406
Plus Motorola M-135 (360/560 channels) and omni	$19,445
Plus ARC Starflite II VHF and omni	$19,650†

* Price of 1961 standard airplane was $15,995.

† For deliveries beginning January, 1962.



There's business out there.

You're looking at more than a horizon. It's a future, yours and America's. Out there is Europe and Latin America and Asia and Africa. But in 1960, of all U.S. manufacturers, less than 5% saw these foreign shores for what they are worth: a 19-billion-dollar export market, a vast source of foreign trade.

Move in for your share. Build your business and help keep America growing. Extra production creates more jobs, helps balance the outflow of gold, and wins new friends abroad with U.S.-made products.

Even if you've never sold overseas, you have a rare opportunity to start—now. Your U.S. Department of Commerce will help with counsel by experts on what, where and how to sell—with data on credits, payments and financing. A package of invaluable know-how is yours for the asking.

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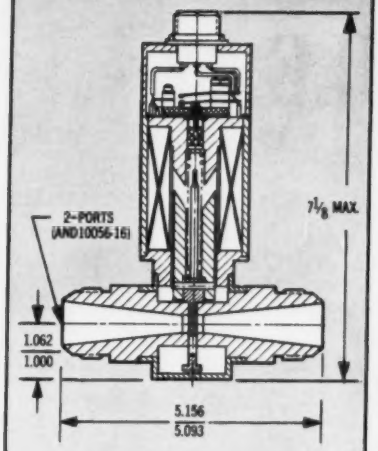
Cryogenic solenoid valve features direct action and venturi flow!



A direct-acting, high-flow, **floating seal** solenoid valve designed especially for cryogenic service! Valcor's unique Series V-41600 features an unusual leakproof design — all external joints inert arc-welded by special process. Flow of fluid media contacts only all-metal surfaces, avoiding cold-temperature shortcomings of non-metallic seals. BEST KNOWN DESIGN FOR LOW TEMPERATURE APPLICATIONS . . . Compression spring "snaps shut" the floating seal when the valve is deenergized for **fail-safe action!** Flow is equivalent to .850 diameter sharp edge orifice.

Larger sizes also available featuring Valcor's new Multiple Venturi Principle.

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pany definitely does not plan to enter the model numbers race—primarily since it is more interested in building volume rapidly and because it feels that distributors and dealers will be able to grow faster on the basis of high turnover of a few types, without bearing the burden of having to maintain an expensive inventory of demonstrator models.

"We are definitely shooting for high volume," he said, "and we don't plan on having the factory get fat while the dealers eke out an existence, like the automotive industry has done."

In the calendar year ahead, Rachal expects Mooney to produce 512 units, which should give the company a dollar volume for 1962 of $7 million. This would be approximately double Calendar 1961's rate, which he expects will result in production of 330 airplanes and a dollar volume of $4.5 million. Calendar 1960 recorded 172 airplanes and a dollar volume of approximately $2.78 million. Rachal told AVIATION WEEK that he expects Mooney to produce 750 units in Calendar 1963. Later he told dealers and distributors that he expects the company's dollar volume to reach $20 million in 1965, $50 million in 1970.

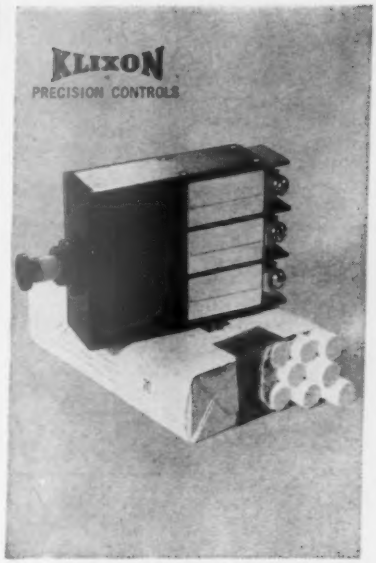
Production Increase

Production volume will step up to two a day beginning the end of this month, he said, from current eight planes weekly now, and the two daily output rate will stay in effect all of the year ahead.

To meet these product volumes, Mooney will have to expand its dealer-distributor network rapidly, he acknowledged. Current organization consists of about 100 distributors and dealers, approximately half of which are in the former category. Goal is to increase the present organization by 50% in the next 12 months.

This may prove one of the toughest goals to attain and indications are that the company considers this figure on the optimistic side. Its competitors, who also are engaged in rapid expansion of their field sales organizations, have similar growth goals and their experience in the past two years has been that they have fallen far short of being able to obtain quality dealers and distributors in the quantities desired, even by going outside aviation and bringing in people with distribution experience from other industries with sufficient capital to establish a distributor or dealer operation. Then, too, the business flying industry has noticed that the newcomers require a far longer learning curve than they have anticipated.

As regards the new models that Mooney plans to have constitute its line over the next few years, it appears cer-



GUARD LOW-AMP ELECTRONIC CIRCUITS!

New single-button 3-phase thermal circuit breaker combines small size and fast response!

This compact package integrates three miniature push-pull circuit breakers to bring unprecedented 3-phase protection to electronic components and cable in the ½ to 10 amp range. An overload on any one phase trips all three breakers — and releases the single indicating button. When the button stays in, everything's "A-ok".

Tripping response is comparable with the speed of a slow-blow fuse . . . 2 to 20 sec at 200% rating. Since the KLIXON 7276 breaker is thermally responsive, it avoids nuisance trips on harmless current transients.

For complete performance and test data on the new KLIXON 7276 3-phase circuit breaker, write for Bulletin CIRB-27.

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This is an advertisement offering scrap materials *Number 9 in a series*

For Sale:

MERCURY CAPSULE SWITCHES

These surplus switches (some slightly used) were designed and manufactured by us for the Mercury Man-In-Space vehicle program. Due to limited number of launches, we are over-stocked. All switches and indicator lights are of absolutely highest quality—perfect for any military or industrial application.

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1420 Delmar Drive, Folcroft, Pennsylvania

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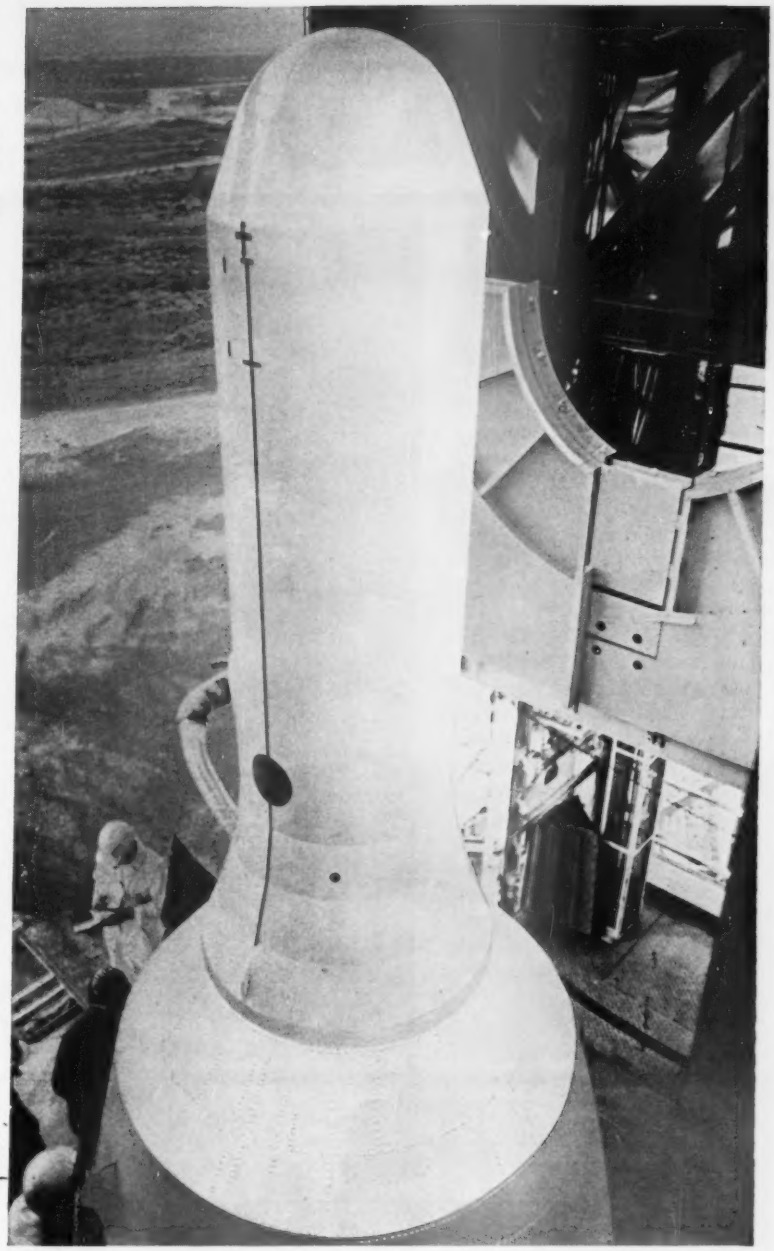
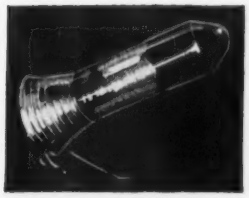
HITCO- developed fabrication techniques are now providing portions of the heat shield for production Atlas and Titan nose cones





ABLATIVE MATERIALS ENABLE FIRST ICBM NOSE CONE RECOVERY
This RVX1-5 was the first nose cone to travel full ICBM range and be successfully recovered intact. Speeds up to 15,000 mph, temperatures to 12,000°F, high heat inputs, and high acceleration and deceleration forces were encountered. The RVX1-5 was enabled to withstand these severe re-entry conditions through the use of REFRASIL[1] and AVCOITE[2] ablative heat shield materials.

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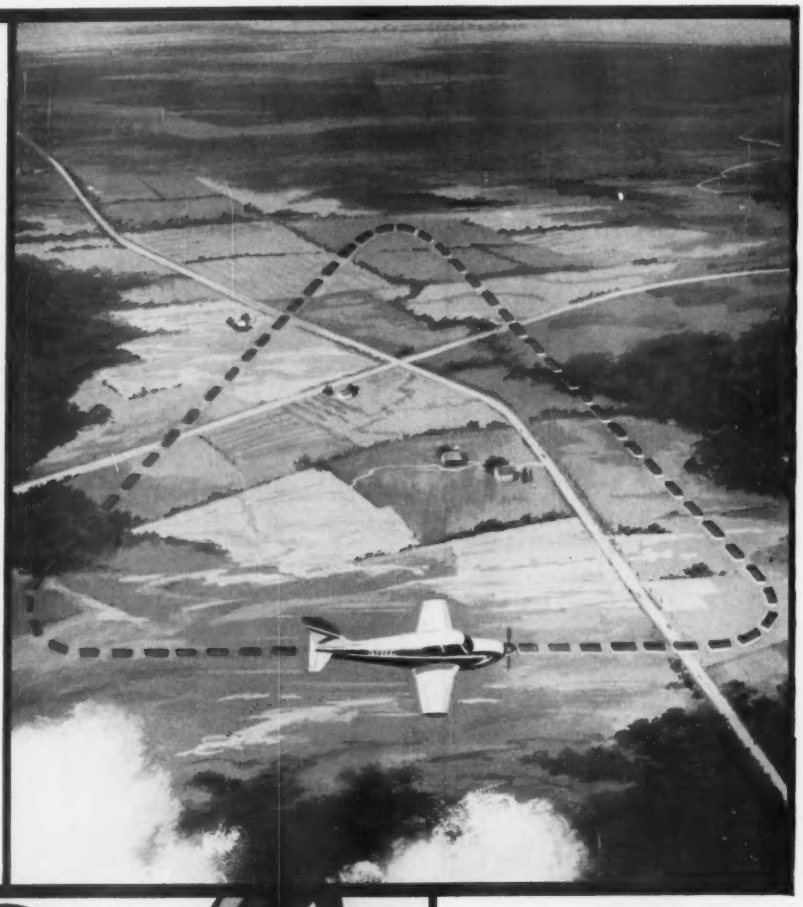
[1] *REFRASIL is a registered trade mark of H. I. THOMPSON FIBER GLASS CO.* [2] *AVCOITE is a registered trade mark of the AVCO CORPORATION.*

ESSO WING TIPS

WHEN LOST IN FLIGHT —EMERGENCY PROCEDURE

If you're ever lost, here's what to do: WITH RADIO CONTACT: Tune to emergency frequency 121.5 mc. Fly a triangular pattern to the right in 2 minute legs with 1½° per second turns of 120°. Complete a minimum of two patterns before resuming course. If radar contact is established, instructions will be given on 121.5 mc. NO RADIO CONTACT: Fly a triangular pattern to the left in the manner described above. If radar contact is established, a Search & Rescue plane will be dispatched for interception. Resumption of course will not compromise this system as your plane will continue to be tracked as "distressed" from the point of initial radar contact. If possible, repeat the procedure each 20 minutes until instructions are received or interception by Air Rescue Service is accomplished.



READ ABOUT THIS NEW ASHLESS OIL!

New Esso Aviation Oil E is an ashless dispersant oil—tested for over 15 million engine miles. What did these tests reveal? This new oil reduces engine deposits, which means that it helps prevent engine wear and oil consumption. Every major U. S. aircraft engine manufacturer has cleared this oil. So next time you land, taxi over to the Esso Sign.

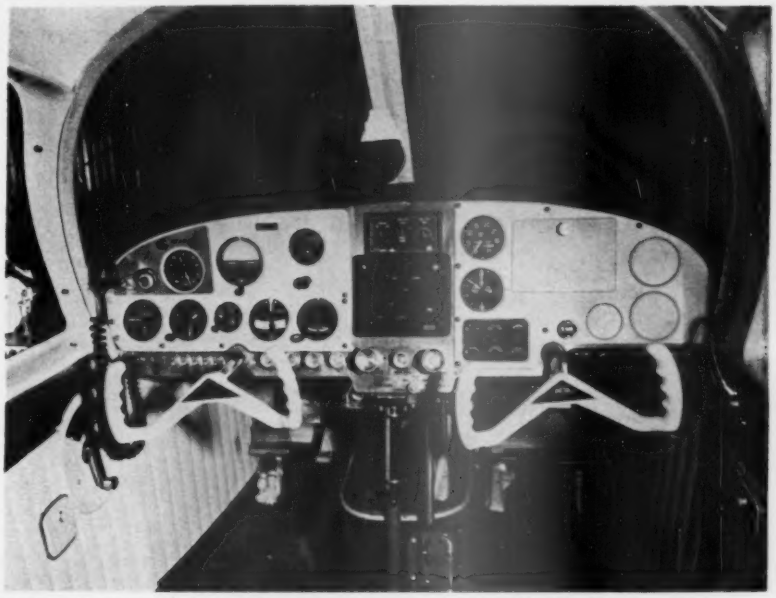
HUMBLE OIL & REFINING COMPANY ESSO

tain that one of the three airplanes will continue to be constantly refined versions of its present Mark 21—company spokesmen foresee an additional 10 years life for this basic airplane.

Although details are not forthcoming on the other two airplanes, AVIATION WEEK learned that the company's current market philosophy is to keep its product line in the under 6,000-lb. weight class at least over the next five years. Since one of the new products apparently will be a light-twin, this would place it in the same family as the Beech Baron and Travel Air, the Cessna 310 or the Piper Aztec and Apache. The other airplane will be a new single-engine type, probably the so-called "heavy single-engine" class, such as the Beech Bonanza, Cessna 210 or Piper Comanche 250. In both categories, Vice President-Chief Engineer Ralph Harmon is shooting for design breakthroughs that will provide major performance and utility gains over these competitive brands while not engaging in a horsepower race. Emphasis would be on capitalizing on aerodynamics and new construction techniques, rather than making performance gains using brute force of larger powerplants.

Indications are that work is well under way on the drawing boards on the next airplane to join the basic Mark 21 and that chances are good that it will be available in the next 18 months.

MOONEY FORESEES another 10 years of life for the present Mark 21 basic design.



MARK 21 INSTRUMENT PANEL has Garwin gages grouped by function.

Mark 21 Changes

In the interim the basic Mark 21 provides the base for future growth development. The 1962 C-series four-place airplane externally varies little from the previous airplane, which underwent major rework last year while retaining the basic design (AW Jan. 16, 1961, p. 108).

Externally, changes are few, the McCauley propeller being replaced in 1962 by Hartzell's new model HC-C2YK/7666-2 74-in. constant-speed controllable-pitch model. The engine cooling cowl flaps have been made four-inches longer than last year to provide improved fairing. These flaps open a maximum of three degrees, which is less than last year's model and are said to give improved cooling with less drag. Engine cowling also now has an access panel on the left upper side for the battery.

Major improvement over the 1961 model is an increase in wing flaps deflection—C-series airplane flaps can be depressed 33 deg. compared with previous maximum deflection of 21 deg., providing better landing control and handling characteristics. Increased deflection was made possible by replacing the former mechanical system, which was unable to cope readily with the forces that rise rapidly after more than 21 deg. deflection, with a hydraulic system that is tapped off the airplane's wheel braking system. Flaps are now lowered by pushing the flap release button, located under the throttle and cycling the flap handle, each full movement lowering the flaps approximately seven degrees, and requiring approximately four and a half cycles of the handle to obtain full deflection. Retraction is accomplished by pulling the flap release control outward. A restrictor valve in the hydraulic system prevents sudden flap retraction, with possible adverse effects.

Rudder Travel Increased

Rudder travel is also increased five degrees to a total of 23 deg., providing improved control, particularly under crosswind conditions.

Skin gages on the elevators and rudder have been decreased and the elevator balance weights reduced to affect a weight saving of some 40 lb., Ralph Harmon pointed out. The airplane's empty weight is now up some 35 lb. over last year's airplane and gross weight is up 125 lb. Weight savings now permit carrying four passengers and 55-80 lb. of baggage, full fuel and normal radio equipment inside the legal limit.

Interior Revision

Interior has been revised considerably, particularly the instrument panel which now utilizes a full complement of Garwin gages as standard. Harmon pointed this feature out as a symbol of Mooney's going to a systems concept in planning various areas of the airplane. By delegating one manufacturer, in this case Garwin, Inc., this responsibility, he feels that a superior design with greater coordination in layout and function results over system of trying to arrange a panel utilizing varied and individual equipment.

Engine group, for example, provides fuel capacity reading in pounds rather than in gallons, oil temperature, oil pressure, cylinder temperature and ammeter

You decide where and when you want to go. The Lockheed JetStar, world's fastest business plane, takes you there with jetliner speed, comfort and reliability. Because it operates from fields of less than 5,000 feet, it can fly direct to hundreds more airports than the big jets—and make better point-to-point time. Four Pratt & Whitney Aircraft JT12 turbojet engines power the JetStar. Each weighs but 436 pounds yet develops 3,000 pounds thrust. This high thrust-to-weight ratio contributes to the JetStar's short field take-off, its jet-performance climb, and its cruise speed of 500 to 550 miles per hour at up to 45,000 feet. The JT12's simple, rugged design ensures high reliability and easy maintenance. And it is backed by Pratt & Whitney Aircraft's worldwide service.

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in one cluster. The manifold pressure is combined with the fuel pressure gage and the tachometer is located directly above the manifold pressure gage, for easier reading. Vacuum pressure indicator has been deleted—instead a simpler go, no-go system of "high" and "low" lights is used—the "high" light indicating a regulator stuck on the high side, above the vacuum required for proper gyro operation and the "low" light indicating that there is vacuum pump failure.

Cabin Trim

New cabin interior trim represents another departure by the company, whereby it is reducing its upholstery operations and buying nylon material dielectrically attached to sound absorbent backing panels from an automotive supplier, Superior Trim Co., Findlay, Ohio, which are simply snapped into place. Mooney claims the new system is superior to its previous method and that the system is lower in cost.

Engine exhaust system was turned over to Hanlon-Wilson for specialized design and the result is a system that Harmon claims is better tuned to the engine's exhaust impulses, with reduction in back pressures and improvement in noise characteristics. The same company simultaneously improved the heating system so that 50% more cabin heat is available while carburetor heat characteristics are also markedly improved.

Engine and propeller controls were also designed on a systems basis by H&E Controls, Tulsa, Okla.

Mooney Mark 21C

Maximum gross weight	2,575 lb.
Empty weight	1,525 lb.
Useful load	1,050 lb.
Maximum baggage capacity	120 lb.
Fuel capacity	48 gal.
Maximum cruise speed (75% power) at 7,500 ft.	180 mph*
Optimum cruise speed (67% power) at 7,500 ft.	172 mph*
Economy cruise speed (55% power) at 10,000 ft.	164 mph.*
Stall speed (power off, gear and flaps down)	57 mph.
Stall speed (power on, gear and flaps down)	54 mph.
Best normal climb speed	105 mph.†
Best on course climb speed	120 mph.†
Normal range, no reserve (9,000 ft.)	915 mi.
Maximum range (12,000 ft.)	1,130 mi.
Powerplant	1 Lycoming O-360-A-1D at 180 hp. at 2,700 rpm.

* True airspeeds, based on gross weight and standard equipment.
† Indicated airspeeds.

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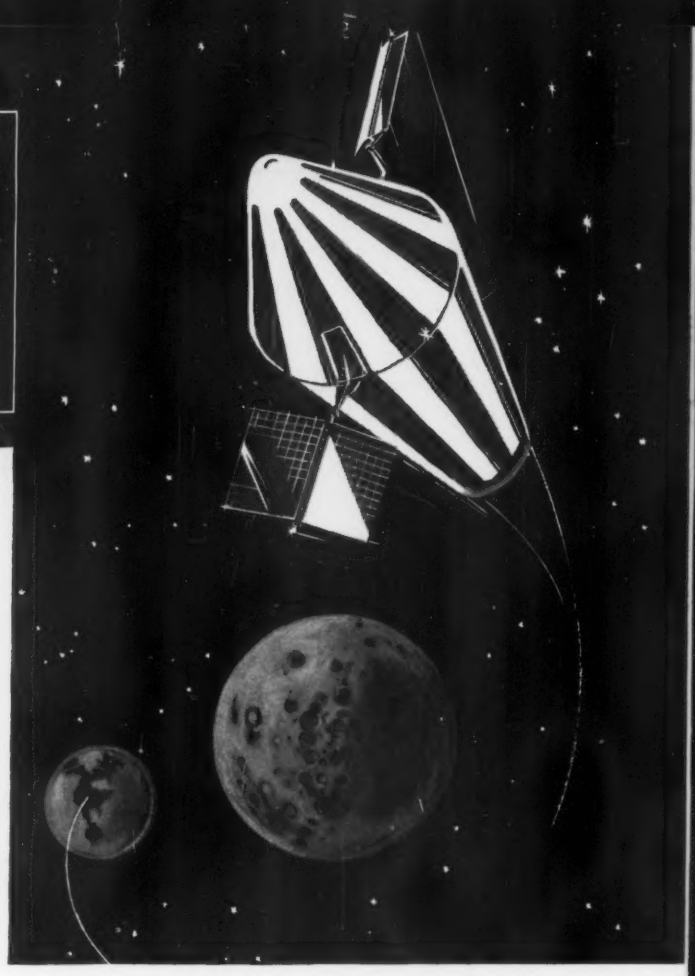

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Over the years, as Beech Aircraft Corporation has constantly developed its capabilities in the fields of design, development, fabrication and testing, it has acquired equipment, skills and experience that has enabled Beech to make invaluable contributions to the solution of many challenging problems related to the missile and aerospace age.

Current projects of Beech Aerospace Division include R&D on manned aircraft; missile target and reconnaissance systems; complete missile systems; electronic guidance systems; programs pertaining to liquid hydrogen propellants and cryogenic tankage systems; environmental testing of missile systems and components; and GSE.

With this background, Beech is in a position to undertake many new projects in the missile and aerospace fields with the assurance of a "head start" toward their rapid and successful completion.

May we discuss how Beech can put its capabilities to work for you? Write, wire or phone Roy H. McGregor, Manager — Contract Administration, Beech Aircraft Corporation, Wichita 1, Kansas—or one of the offices listed below.

In which of these areas can Beech help you save time and money?

- ☐ CRYOGENICS
- ☐ MISSILE SYSTEMS
- ☐ MISSILE TARGET AND RECONNAISSANCE SYSTEMS
- ☐ MANNED AIRCRAFT
- ☐ SUPPORT EQUIPMENT
- ☐ RESEARCH AND DEVELOPMENT
- ☐ ENVIRONMENTAL TESTING
- ☐ _____

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P. O. Box 17187
BRoadway 3-1335

HUNTSVILLE, ALABAMA:
Mr. T. Bruce Cooper
Manager, Southeast Area
Beech Aircraft Corporation
Suite 116, Sahara Office Park, S.W.
53-94631

U.S. Business & Utility Aircraft Shipments

(July, 1961)

Make & Model	Number of Units	Net Factory Billings
Aero Commander 500A, E	5	$410,000
560F	1	
Beech 18 Super	2	$3,238,000
33 Debonair	7	
35 Bonanza	20	
50 Twin-Bonanza	1	
55 Baron	18	
65 Queen Air	7	
95 Travel Air	12	
Callair A-5	2	$13,000
Cessna 150	35	$3,008,000
172, Skyhawk	59	
175, Skylark	5	
180	10	
182, Skylane	46	
185 Skywagon	35	
210	9	
310	12	
Champion 7EC Traveler	2	$91,000
7FC Tri-Traveler	4	
7GCB Challenger	7	
7 GCBA Agricultural	1	
Lake LA-4 Skimmer	2	$47,000
Mooney Mark 21	30	$554,000
Piper PA-18-150 Super Cub	22	$1,755,000
PA-22-108 Colt	72	
PA-22-150 Tri-Pacer	1	
PA-23-160 Apache	1	
PA-23-250 Aztec	12	
PA-24-180 Comanche	7	
PA-24-250 Comanche	21	
PA-25-150 Pawnee	20	
PA-28-160 Cherokee	12	
Totals	500	$9,116,000

Note: January through July 1961 shipments totaled 4,128 aircraft having a total net billing value of $76,052,000. This compares to 4,412 aircraft shipped having a total net billing value of $86,598,000 in the same period last year. July's unit deliveries show a gain of three aircraft over the same month last year, but billing value is down from July 1960's $9,835,000.

Hispano Developing Executive Turbofan

Madrid—Spain's Hispano Aviacion is developing a twin-jet six-place executive transport built around components of its HA-200 Saeta trainer.

Planned all-metal aircraft, powered by two Turbomeca turbofan engines of 1,540-lb. thrust each, joins at least six other executive jets in being or under development within Western Europe and the United Kingdom.

Designated the HA-230, the plane retains the wing, tail section, tip tanks and landing gear of the Saeta trainer. The pressurized cabin is designed to maintain an altitude equivalent of 9,000 ft. at altitudes of up to 36,000 ft.

Range, including climb to 29,527 ft., is more than 1,600 mi., according to Hispano. Cruise speed is quoted at 420 mph., landing speed at 100 mph. The company estimates the required takeoff run at 2,200 ft. at a maximum gross weight of 8,378 lb.; a landing roll of 1,660 ft. at 6,614 lb. Fuselage length of the aircraft is 31.65 ft.; wingspan, 36.65 ft. Maximum height is 10 ft.

Hispano says the HA-230 will be delivered with a full range of instrumentation, including auto pilot, weather radar, ILS, VOR and a VHF or UHF transceiver.

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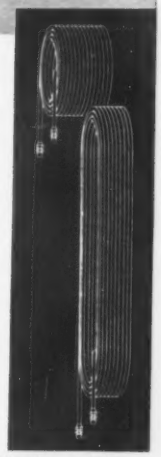

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See page 92

ULTRAgraph

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Soon, B.E.A. will be doing the same on their all-freight routes. Argosies will open up new high-speed supply lines for outsize cargoes between the U.K. and Europe.

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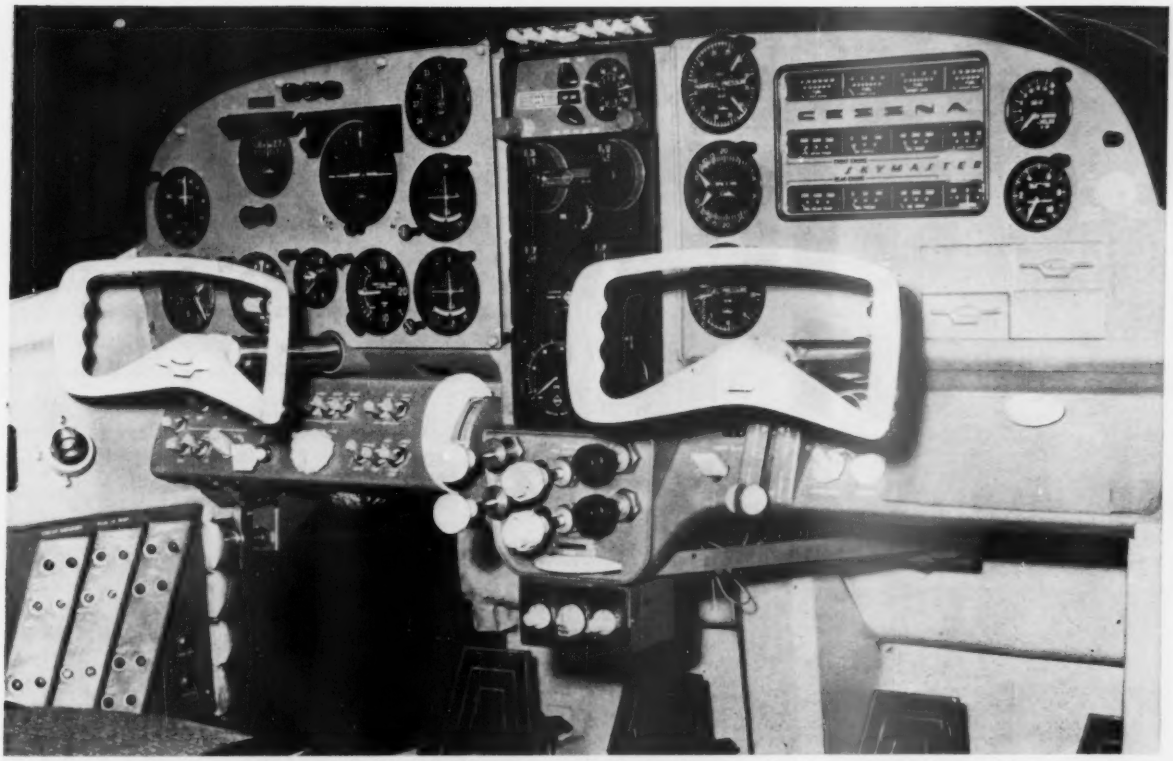
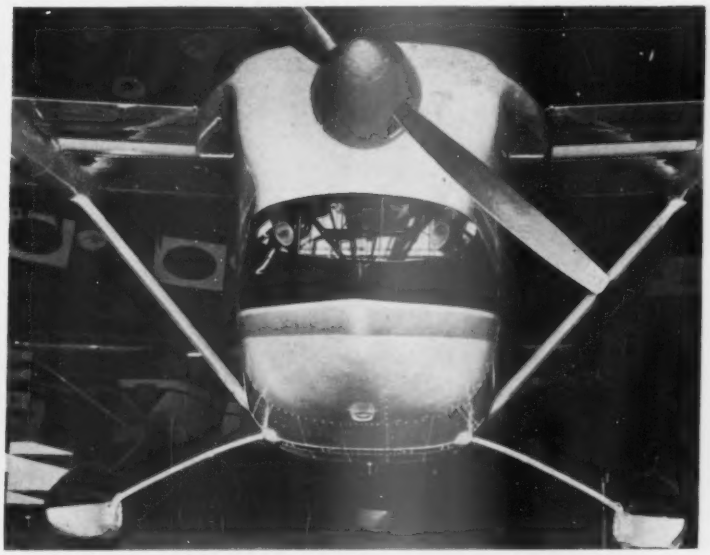


Skymaster panel, in cabin mockup, was described by Cessna as production configuration. Engine and propeller controls are paired, one above the other, below the radio, which is mounted in the center of the panel. Throttles, left, and propeller controls, center, are designed for one-hand operating and are staggered to prevent inadvertent mishandling. Flight instruments are directly in front of the pilot, at left. Engine gages are at right. Fuel gages in rectangular panel, upper right, indicate 15 gal. for each auxiliary tank and 50 gal. for each main tank. Wing flap indicator shows four positions; 10, 20, 30 and 40 deg. Manifold pressure, engine rpm. and fuel pressure gages, to right of radio, combine reading for both engines on one face for each indication.

Skymaster Panel, Engine Configurations Revealed



Air inlet for Skymaster's pusher-mounted engine, left, from the front, shows adjustable intake ramp at bottom. Pusher-mounted Continental IO-360-A engine is fed by two air inlets, one on each side of the fuselage, just under the trailing edges of the high wing. Powerplants for the aircraft are six-cylinder, air-cooled horizontally opposed types and develop 210 hp. at 2,800 rpm. on takeoff and 195 hp. at 2,800 rpm. at 2,100 ft., using 100/130 octane fuel. Direct-drive pusher-puller engines weigh 293 lb. each and are interchangeable.

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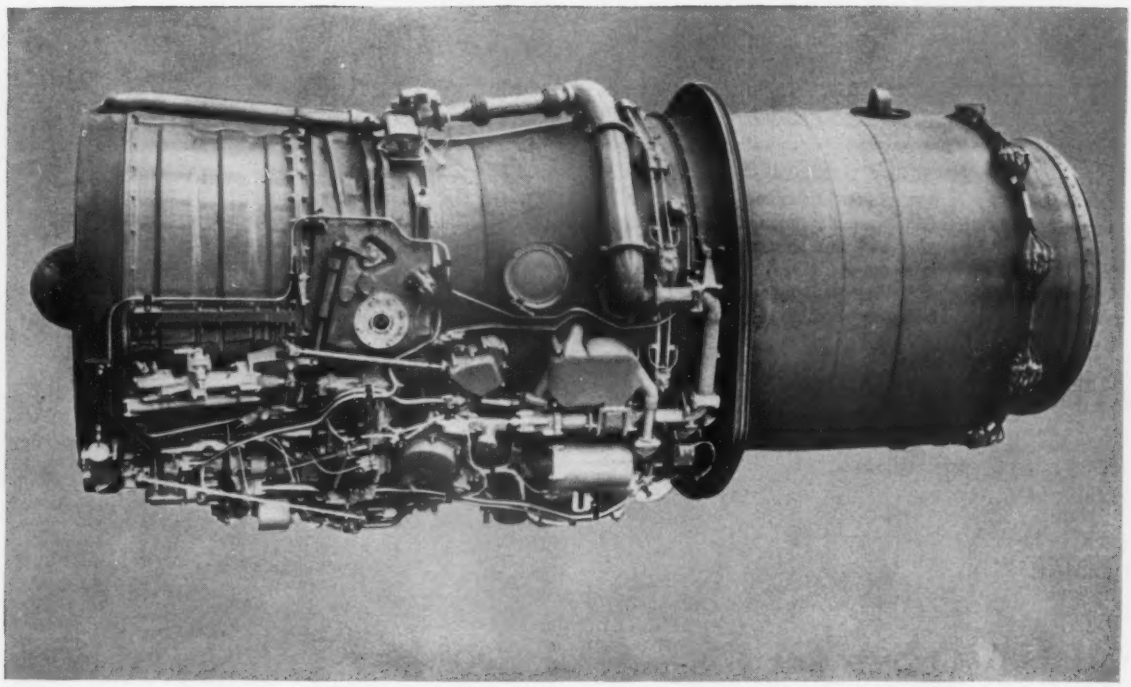

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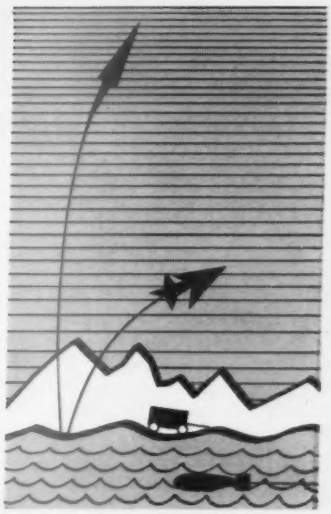

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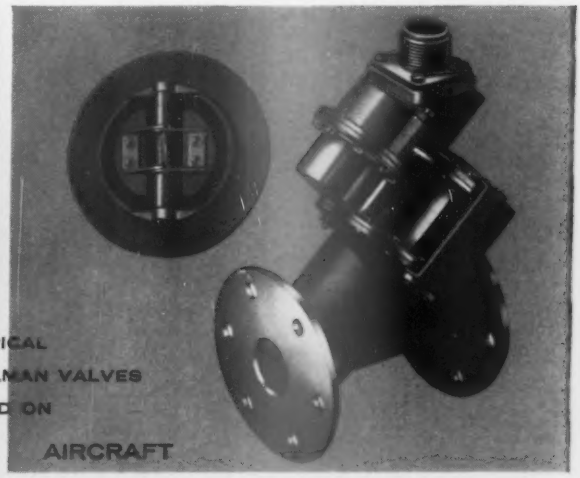

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Lockheed Earnings May Top $25 Million

By James D. Hendricks

New York—Defense and aerospace programs diversification has given Lockheed Aircraft Corp. a good balance in rounding out its skills in those areas and should help pave the way toward increasing sales and earnings, according to Board Chairman Courtlandt S. Gross.

Gross, elevated from president to chairman in September following the death of his brother, Robert, the former chairman, (AW Sept. 11, p. 33) told the New York Society of Security Analysts that Lockheed earnings may reach more than $25 million this year.

He added that profits should be "considerably better" in 1962, with sales rising from a projected $1.4 billion for 1961 to about $1.5 billion next year.

"We have reached a sort of diversification plateau," Gross told the analysts. "We shall pursue diversification aims with somewhat less a sense of urgency, and we shall apply a high degree of discrimination and judgment in evaluating new opportunities."

The Lockheed chairman cited extension of non-military business as one of the firm's long-term diversification goals. He gave the following percentage breakdown for Lockheed's business this year:

Missiles, 27%; space projects, 26%; aircraft and related services to the U. S. government, 20%; aircraft and service to foreign governments, 16%; commercial aircraft spares and services, 6%, and 5% in shipbuilding, electronic end products, propulsion and other fields.

Gross said some of the newest Lockheed acquisitions "have had quite a struggle," adding that the company had partially expected these problems. He discussed the status of three recent additions to Lockheed:

• **Puget Sound Bridge & Drydock,** Seattle, Wash., is "profitable, but not as profitable as we would like," Gross said. He noted, however, that the firm "is doing well with a good backlog and a much higher business and employment level than when we acquired it . . . We have a good and experienced management group there, we are pleased with them, and we are confident they will keep this business going well."

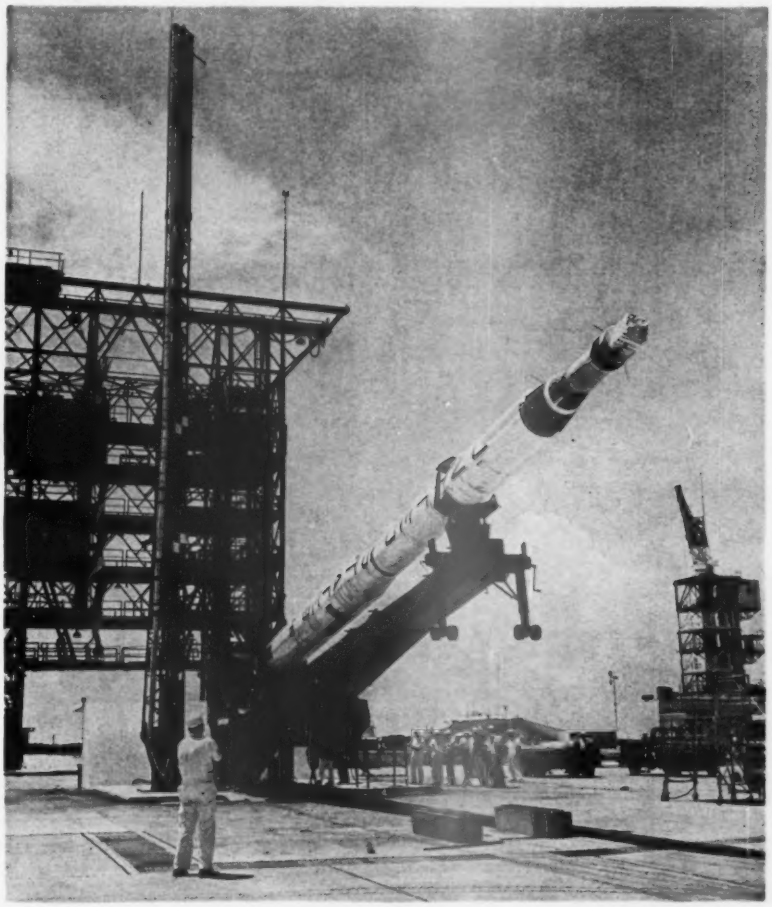
• **Lockheed Electronics Co.** of Plainfield, N. J., "is still in the red and likely to remain so for some months to come," Gross reported. "We are building up a fine production business in ferrites, printed circuit boards and some other items, but we are investing and spending for additional research and product development to push for more rapid growth."

• **Lockheed Propulsion Co.** of Redlands, Calif., formerly Grand Central Rocket Co., also is in the unprofitable column, Gross noted. "Now that we have secured complete ownership (AW Nov. 6 p. 34), we are trying to streamline its operations, and we are assisting it with plans to capture a larger share of the growing solid fuel business."

Presenting the company's third quarter report to the analysts, Gross based his predictions for a possible $25 million or more in earnings this year on an expected continuation through the fourth quarter of the company's upward trend of income during the first nine months of 1961.

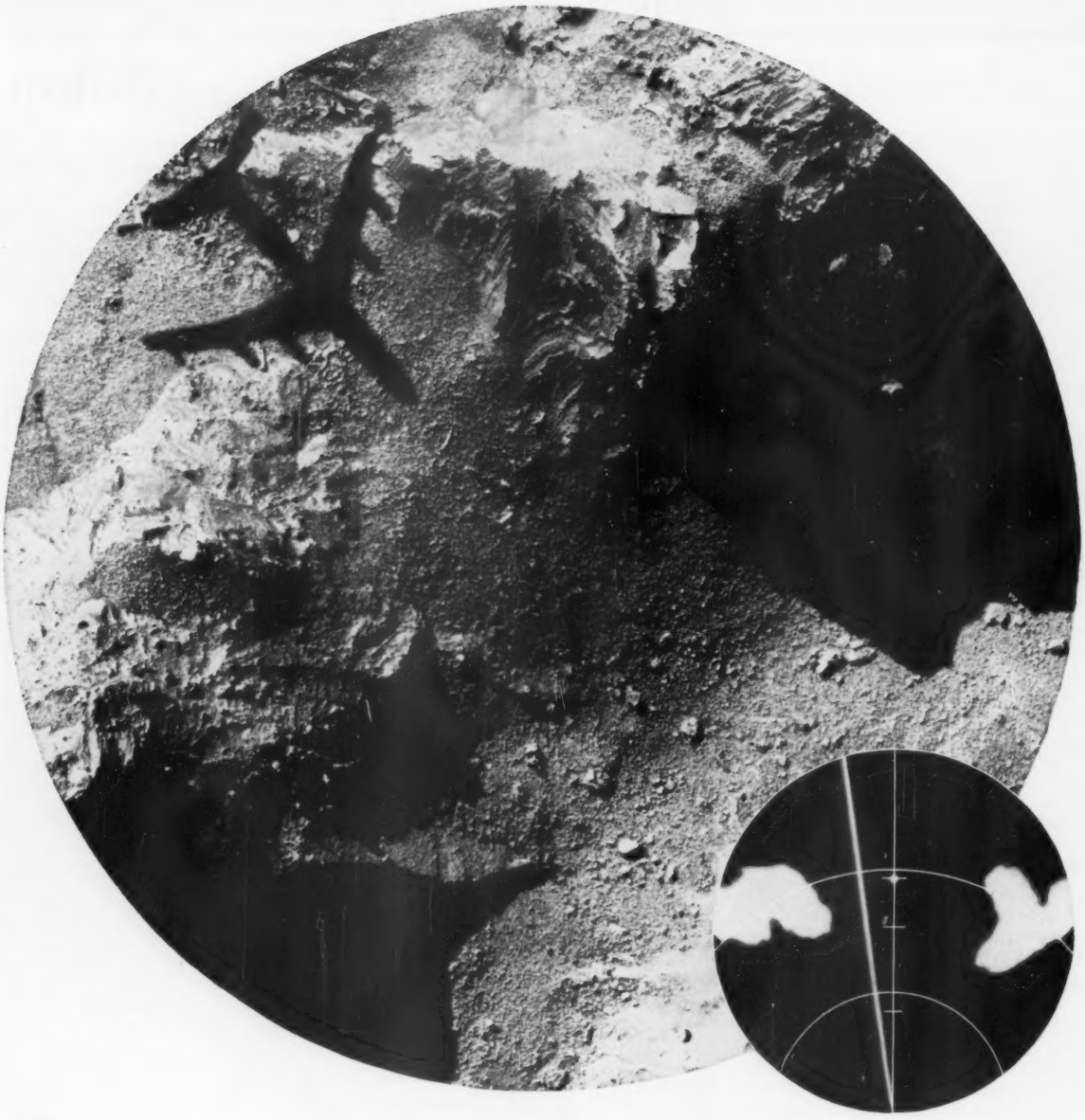
Third quarter earnings were $7,279,000 or 96 cents per share resulting from sales of $316,279,000. This compared with third quarter 1960 earnings of $5,485,000 or 74 cents a share on sales of $305,221,000.

Nine months net profit this year was $16,502,000 or $2.20 per share based on sales of $995,442,000 compared with a net loss of $49,924,000 or a loss of $6.90 per share on sales of $964,768,000 through the same period in 1960. Backlog on Sept. 24 this year was $1,700,981,000 compared with $1,387,179,000 on the same date in 1960.



Blue Scout on Mercury Mission Is Destroyed

This Blue Scout vehicle, shown with payload shroud removed during checkout at the Atlantic Missile Range, was destroyed 30 sec. after liftoff, Nov. 1, when it deviated from its trajectory. The payload, a 150-lb. communications satellite package, was to have tested the Project Mercury tracking network during orbital passes. Blue Scout is fin-stabilized and controlled by jet vanes during the boost phase.



ENGINEERS ARE CHARTING A NEW COURSE AT AC

AC's newest assignment is Systems Integrator for the modified B-52C&D Bombing Navigation System. AC's responsibility includes program and engineering integration, and coordination of associate contractors in the production phase. ■ Other programs at AC include a new, miniaturized inertial guidance system for the TITAN II missile. In addition, AC's Los Angeles Advanced Development Laboratory is currently developing Advanced INertial Guidance Systems. ■ AC is seeking qualified men to work on these important projects. If you have a BS, MS or PhD in Electrical Engineering, Mechanical Engineering or Physics, please contact Mr. G. F. Raasch, Director of Scientific and Professional Employment, Dept. 5753, 7929 South Howell, Milwaukee 1, Wisconsin. An Equal Opportunity Employer. ■ Immediate positions available:

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Lockheed reported a loss of $42,924,000 at the end of last year on sales of $1,332,289,000.

Gross recalled that the 1960 loss was mainly attributable to large writeoffs on the Electra turboprop transport and JetStar medium jet utility transport programs. He said Lockheed has pretty well shaken off both setbacks.

"The Electra problem, we feel, is now behind us," Gross observed. "There still remain five unsold Electras [the result of a canceled order last year by Capital Airlines], but we believe we can sell these."

JetStar sales have gone slower than hoped, Gross admitted, and the company has recorded an additional writeoff of about $1.5 million for the third quarter. He pointed out, however, that Federal Aviation Agency certification of the plane and its inclusion in the military inventory should result in an increase of commercial orders.

"We are very much interested in the supersonic transport," Gross added. "For the first time since World War II, Lockheed is not in production on a commercial transport. But this is an area of high competence in our company, and we by no means intend to write ourselves out of the commercial aircraft market. We have already done much research in the supersonic field, and we will compete when the time for competition comes."

Foreign production of Lockheed's F-104 Starfighter offers the company profit potentials on license and royalty fees and payment for technical services, the Lockheed chairman noted. Although production in the six foreign countries is "on the order of one fourth as profitable as if we built the airplanes ourselves," Gross said, the program is beneficial to Lockheed and the U. S. aircraft industry and international relations.

The Starfighter overseas production program will contribute about $1 billion towards solution of the balance of payments problem, Gross added, with that amount divided among more than 600 subcontractors, suppliers, vendors and other firms in this country.

6 Aerospace Firms Report on Earnings

Six aerospace companies released financial reports to stockholders recently, and one of the firms, Republic Aviation Corp. of Farmingdale, N. Y., announced a proposed two-for-one common stock split.

Republic's directors called a meeting for Dec. 15 of stockholders on record Nov. 10 to vote on the proposed split of the company's current 2,500,000 common shares. If the split is approved, it probably will become effective by the

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PROBLEMATICAL RECREATIONS 92

Show that $\tan \frac{\pi}{10}$ is a root of the equation $5x^4 - 10x^2 + 1 = 0$.

– Contributed

We're working on some really *solid* solid state devices in our Guidance and Control Systems Division. Thin film processes to be specific. Interested engineers, conduct yourselves to our Woodland Hills facility. Or if you're attending the Northeast Electronic Research and Engineering Meeting November 14-16, see our man in Waltham, Mass., Norm Weber, 221 Crescent St.

ANSWER TO LAST WEEK'S PROBLEM: Let T = initial position of the minute hand, in minutes after the hour. The initial position of the hour hand is therefore: $(20 + \frac{T}{12})$. The hour hand travels a distance $T - (20 + \frac{T}{12})$, which is 1/12th the distance which the minute hand travels, $60 - [T - (20 + \frac{T}{12})]$, or: $T - (20 + \frac{T}{12}) = \frac{60 - [T - (20 + \frac{T}{12})]}{12}$.

Solving, $T = \frac{3840}{143} = 26.8531\ldots$ minutes and the time is therefore 26.8531 minutes after 4:00.

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end of the year with the shares, now rated at $1 par value, adjusted to 50 cents.

A quarterly dividend of 25 cents per share would be established on the new stock, compared with 50 cents now in effect.

Nine-months net earnings for 1961 were $7,532,062 or $5.21 per share on sales of $256,755,599 compared with $1,572,548 or $1.10 per share on sales of $115,264,645 for the same period last year.

Current backlog was reported at $609 million.

Other reports:

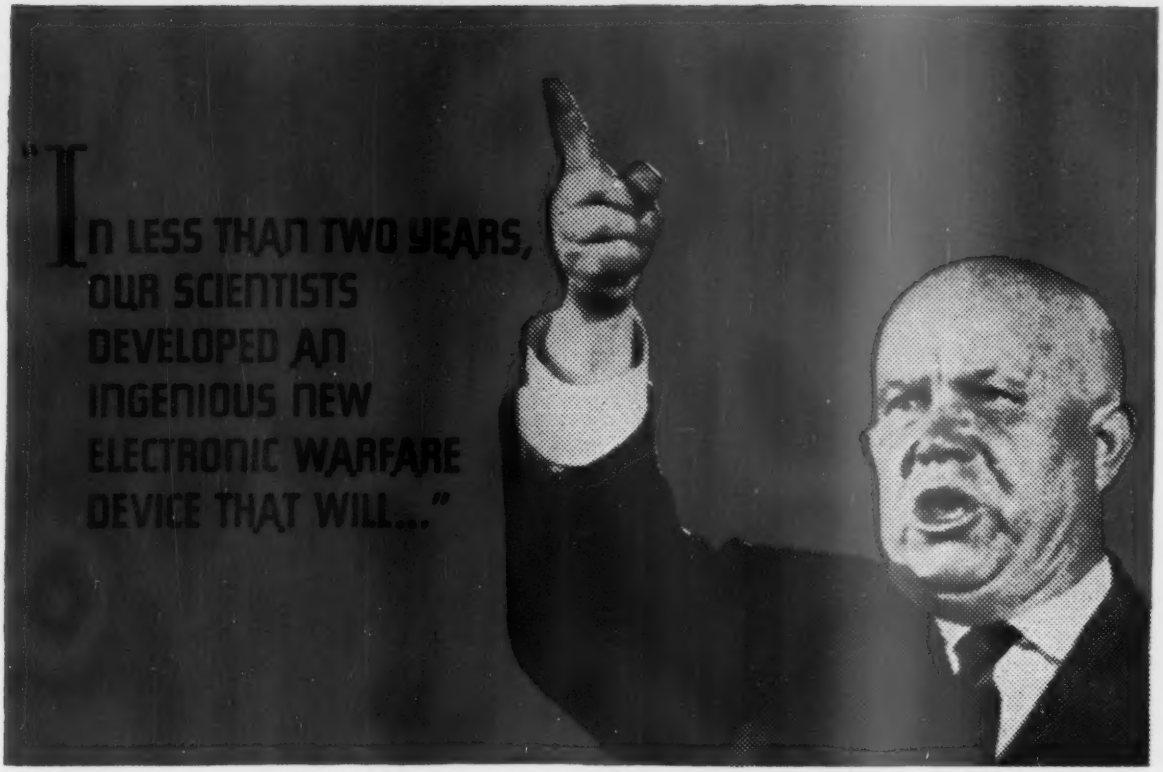
• **McDonnell Aircraft Corp.** of St. Louis, Mo., showed net earnings of $2,646,826 or 77 cents per share (3,425,732 shares outstanding) on sales of $79,600,673 for the third quarter of 1961. Earnings were up 6% over the $2,507,730 or 74 cents per share (3,402,787 shares outstanding) for the comparable period last year, when sales were $84,115,688. Sept. 30, 1961 backlog was $390,351,116 compared with $363,322,783 on Sept. 30, 1960.

• **Northrop Corp.** of Beverly Hills, Calif., reported net income of $8,673,321 on sales of $267,454,965 during the fiscal year ended July 31, 1961, compared with earnings of $7,740,219 on sales of $233,679,427 for the previous year. Net earnings per share were $4.22 on 2,052,880 outstanding shares, the same as in Fiscal 1960 on 1,835,516 shares.

• **Rohr Aircraft Corp.** of Chula Vista, Calif., reported record high earnings of $5,350,678 or $2.74 per share for the year ended July 31, although sales declined from $193,249,182 last year to $168,170,217 this year. Fiscal 1960 loss was $2,604,375 or $1.33 per share. Backlog was reported at $129,835,000 on July 31, 1961, compared with $138,800,000 at the same time last year, but company officials said orders received July 31 have increased the current backlog to $139,340,000.

• **Sanders Associates, Inc.**, Nashua, N. H., reported that sales for this fiscal year are expected to reach $40 million compared with $21.1 million last year.

• **Acoustica Associates, Inc.**, of Los Angeles reported a return to profits during the six-month period ended Aug. 31, with $28,900 net income, equal to six cents per share, on sales of $3,915,000. This compared with earnings of $121,655 or 21 cents per share on sales of $4,187,314 for the same period in 1960. The ultrasonic systems manufacturer had sustained a net loss of $297,629 on sales of $9,243,274 for the fiscal year ended last Feb. 28. Board Chairman Robert L. Rod and President Rollin M Russell noted that during the six months through August, the company increased working capital from $738,000 to $811,000.



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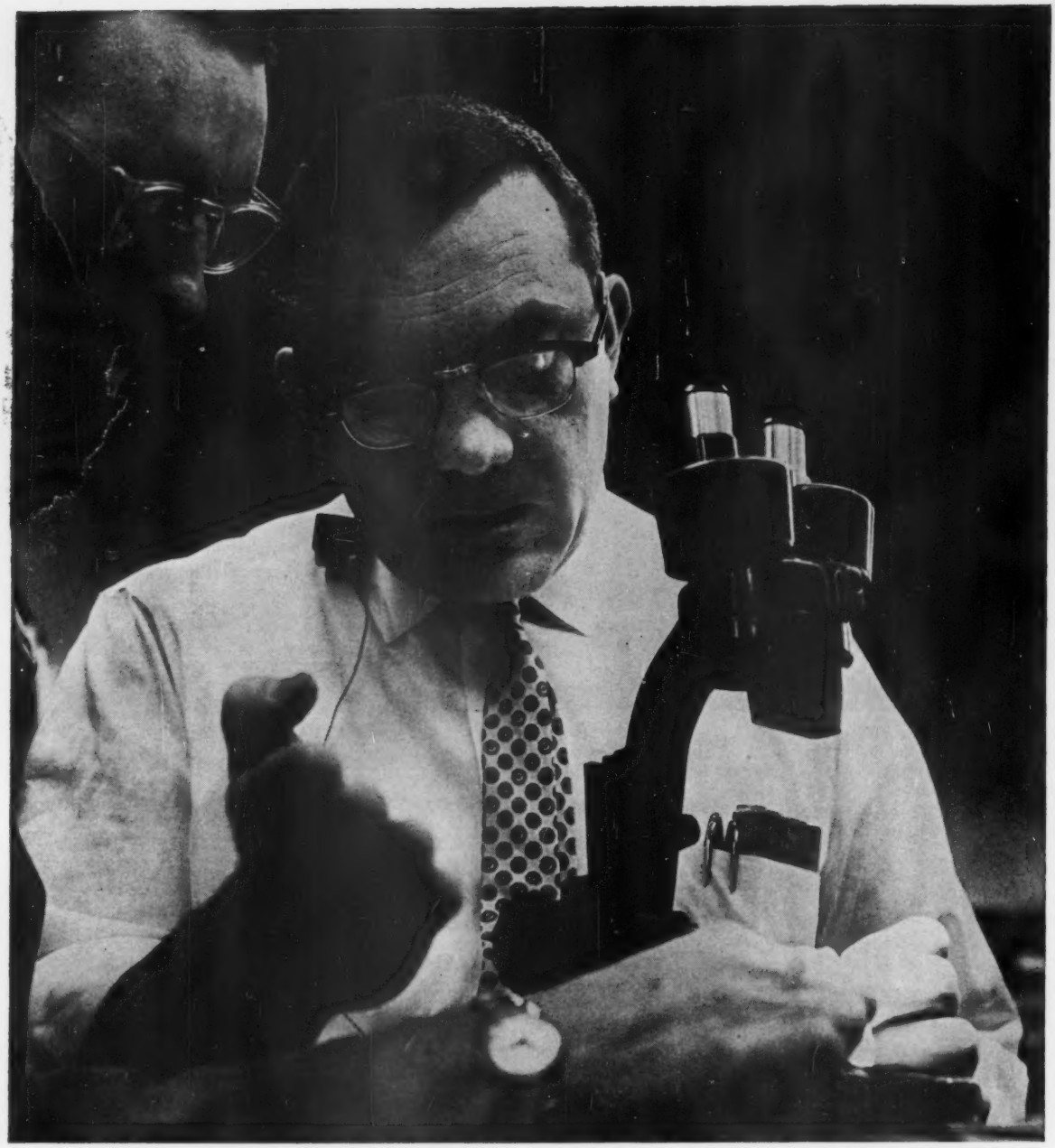

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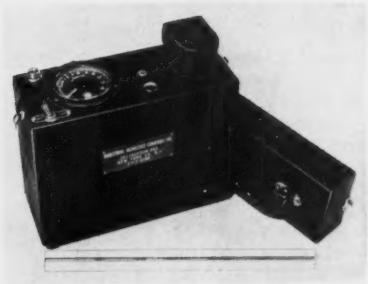

Ground Jet Thrust Indicator

Compact portable device, designated the JTI Model P, can be used for measurement of jet engine thrust during ground checkouts on test stands and aircraft, takeoff on runway or aircraft carrier and in jet aircraft, missile and rocket launching operations.

Weighing less than 7 lb., the indicator can be carried by a strap over a ground technician's shoulders. Instrument meter converts sound power of the engine into thrust measurement. Field calibrations can be performed with an adjustment device on the face of the indicator. A measuring device is provided for determining distance to engine exhaust.

The manufacturer claims the instrument can be adapted for use as a general malfunction detector and diagnostic instrument for aviation, shipboard and land-based equipment.

Industrial Acoustics Co., Inc., 341 Jackson Ave., New York 54, N.Y.

Instrument Test Unit

Airborne Mechanisms Vacuum Instrument Test Kit, is said to perform accurate checks on the ground of light plane air-driven flight instrument gyros and pneumatic autopilots without necessity for starting the aircraft engine.

Unit accurately holds constant vacuum levels from 0-10 in. of mercury. A single control knob permits rapid adjustment to any required vacuum in this range. The kit basically consists of a dry-vacuum pump connected to an adjustable, diaphragm-type suction regulator valve. Constant speed, .5-hp., 115-v., electric motor drives the pump at a pre-determined speed comparable to actual engine operation.

Unit is portable and self-contained, weighing 40 lb. It is mounted in a soundproofed metal case with carrying handle. Dimensions: 16 in. long, 12 in. wide, 10 in. high. Pump exhausts through a muffler.

Airborne Mechanisms, 13229 Shaw Ave., East Cleveland 12, Ohio.

Hydraulic Boom Lift

Cemco Industries, Inc., Sky Platform has been used by the Air Force for more than three years in aircraft decontamination and deicing operations and is now on the commercial market.

The hydraulic lift can rapidly elevate two men in a safety constructed and insulated basket as high as 100 ft. and rotate the basket in either direction up to 360 deg. Twin booms raise the basket from the truck chassis, which is secured in a fixed position by outriggers.

Dual control levers are provided at the ground control panel and in the basket with an override feature in the ground controls. Separate levers raise or lower the upper and lower booms, and a third lever controls rotation.

The equipment is being sold through local distributors.

Cemco Industries, Inc., Galion, Ohio.

Refrigeration Service Manifold

New Model 2404 manifold connects into refrigeration air conditioning systems and is said to cut maintenance down time for those systems as much as 25% on military and commercial aircraft.

The portable manifold is substituted for the receiver-dryer unit in the refrigerating system and is designed for mounting on the same brackets as the receiver-dryer tank.

By centralizing most test controls, the manufacturer claims, the manifold substantially reduces checkout and maintenance setup time. Connect-disconnect operations are minimized to reduce danger of system contamination, and the manifold system provides an integral dessicant unit and filter for further protection. Relief valve prevents over-pressurization of the aircraft system during leak tests. Manifold was originally designed for DC-8s, but is said to be adaptable to other aircraft.

Burton Instruments Division, Burton Manufacturing Co., Northridge, Calif.

Mechanical or Aeronautical Engineers with M.S. Degrees and some research or development experience are required for an extensive research program in advanced rocket propulsion concepts. A comprehensive knowledge of fluid mechanics is required (compressible viscous flows, turbulence, transport phenomena) along with the ability to apply this knowledge to unusual fluid flow problems. Both theoretical and experimental programs are being conducted.

This program has strong corporate sponsorship with all that this implies in personal stability. Available are excellent experimental, computational, and library facilities with experienced supporting personnel. Attractive salary levels and benefits are available to qualified individuals.

We invite you to contact Mr. W. D. Walsh

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Systems Technology at AEROSPACE CORPORATION

The scientists and engineers of Aerospace Corporation are concerned with space and missile systems development in totality—at every stage from concept to system testing. They are systems planners and systems engineers in the broadest sense: interdisciplinary problem-solvers qualified to enjoy unusual creative latitude relatively free of burdensome administrative details.

As the civilian link uniting the Air Force-scientific-industrial team responsible for development of advanced ballistic missile and space systems, they are charged with applying the nation's full scientific and technical resources toward meeting system concepts and objectives in an economical and timely manner.

Within the Systems Research and Planning Division of Aerospace Corporation, these men are concerned with the formulation and initial development of advanced systems concepts to fulfill future Air Force needs in space. Target dates are on the order of two to 15 years and project magnitude extends to billion dollar programs. Activities include: concept generation and evaluation; preliminary design; development program formulation; preparation of preliminary design specifications as the basis of requests for proposals; technical evaluation of industry proposals; direction of industry study and research programs; systems analysis; conduct of critical experiments; state-of-the-art evaluation; and identification of needed areas of research.

Once industry development contracts are awarded, the men of Aerospace Corporation's Engineering Division guide the conversion of system concepts into actual operating hardware. In providing technical direction and supervision for the Air Force, their tasks include over-all systems integration including design compromises between subsystems, recommendations on subsystem trade-offs, and supervision of system testing—all in reference to entire system concepts of major importance. These efforts are directed toward such areas as ballistic missiles; defense systems; space launching systems; early warning, weather surveillance and communications satellites; and systems for developing re-entry, rendezvous and man-in-space capabilities.

Today, continuous growth in Aerospace Corporation's responsibilities creates the necessity for expansion of the Corporation's technical staff. The need is for engineers and scientists who have established a reputation in their field and now desire to exercise their full interdisciplinary capability. Requirements include an advanced degree and extensive experience.

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin and are urged to contact: Mr. George Herndon (OSborne 9-4661, Extension 1171), Aerospace Corporation, Room 101, P.O. Box 95081, Los Angeles 45, California.

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WHO'S WHERE

(*Continued from page 23*)

Changes

Samuel E. Eastman, director of development planning, Technical Operations, Inc., with offices in Washington, D.C. **William P. Murden, Jr.** succeeds Mr. **Eastman** as director of the company's Washington Research Office, Washington, D.C.

D. C. Arnold, chief engineer, Radio Corporation of America's Aerospace Communications and Controls Division, Defense Electronic Products, Camden, N.J.

F. T. Hinkley, commercial director, Aero Engine Division of Rolls-Royce, Ltd., Derby, England. Mr. Hinkley continues as managing director of the International Division.

Dr. Ralph P. Hudson, chief, Heat Division, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C.

Alvin G. Waggoner, executive assistant to the director of research and systems engineering, AIL Division of Cutler-Hammer, Deer Park, N.Y.

Howard E. Harry, engineering manager, Electronics Division, The Ralph M. Parsons Co., Pasadena, Calif.

Joseph S. Pares, general sales manager, Leach Corp., Compton, Calif.

George Nalesnik, assistant general manager, Kearfott Microwave Division of General Precision, Inc., Van Nuys, Calif.

Thomas A. Tharp, manager of General Tire & Rubber Co.'s Washington, D. C., office, succeeding **Harold D. Sill**, retired.

Douglas E. Graves, manager, Boeing Atlantic Test Center, Aero Space Division, The Boeing Co., Cape Canaveral, Fla.

Dr. Claus Haake, research manager, Giannini Controls Corp.'s Research Laboratories, Pasadena, Calif.

Paul R. Obdyke, chief engineer, Remanco, Inc., Santa Monica, Calif.

Gordon L. Ness, instrumentation marketing manager, Fairchild Semiconductor, Mountain View, Calif., a division of Fairchild Camera and Instrument Corp.

Steven M. Sussman, head, Communications Theory Laboratory, Melpar's Applied Science Division, Watertown, Mass.

Harold Niles, government relations manager in charge of the Washington (D.C.) office of Ford Instrument Co., division of Sperry Rand Corp.

Jet Propulsion Laboratory has requested that **Dr. Lewis D. Kaplan**, the University of Nevada's atmospheric physicist, head the planetary exploration studies leading to the U. S. Venus and Mars space probe experiments.

E. A. Fain, assistant manager of sales, Boulder, Colo., division of Beech Aircraft Corp.

Dr. James W. Moyer, director of research, Research and Development Center, Santa Barbara, Calif., of Servomechanisms, Inc.

Dr. Robert S. Carlson, assistant director-research and development, Autonetics, a division of North American Aviation, Inc., Downey, Calif., and **J. N. Schmidt**, chief engineer-inertial navigation.

E. M. Swartz, manager of manufacturing, Idaho Maryland Industries, Inc., Los Angeles, Calif.

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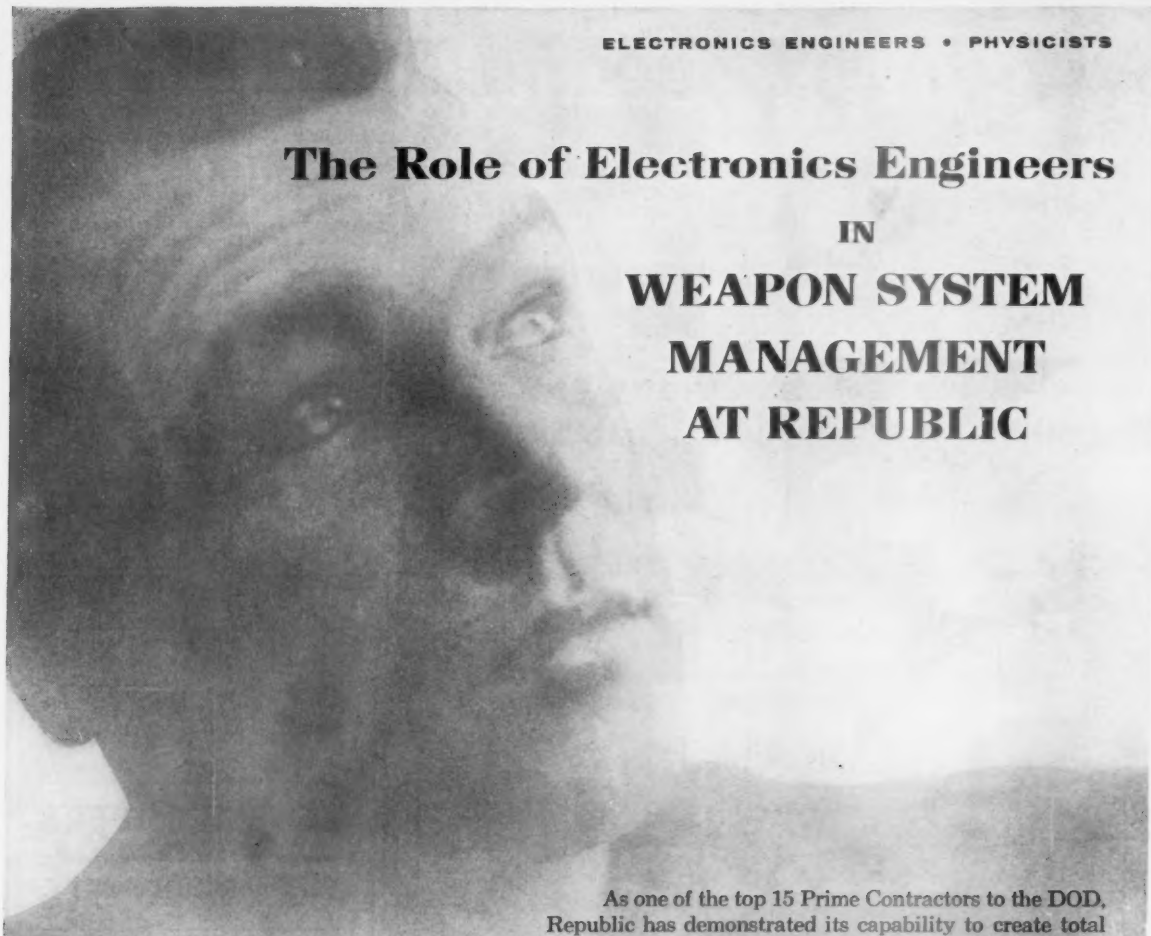

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LETTERS

Suggestion of Survival

For many years I have watched this page provoke much thought and stir much action in the oft-slothful minds of men. Mr. J. R. Pritchard, Jr.'s idea of placing an ejection seat aboard airliners for the survival of one crew member (AW Oct. 23, p. 126) now stirs my indolent imagination. This plan has much merit but it rings of the same bell the mice tried to tie around the cat's neck, viz.: Who gets the honors?

Other small but possibly significant problems arise, such as (1) how do the airlines fill the captain and copilot positions when these men rush to change to the "fortune-smiled-upon" jobs of flight engineer? and (2) how large a salary differential must the "selected one" suffer to compensate for the fringe benefits he receives but may never use?

Perhaps some equally thought-provoked individual as Mr. Pritchard or myself can arrive at the solutions to these problems, but in the meantime passenger safety can be aided by a diligent application of thorough job knowledge, striving to overcome the complacency that comes with years of routine duty, and staying within the realized limitations of our own capabilities and those of our flight control systems and machines.

Capt. Grant S. Pyle, III
Missile Safety Officer
194th Ftr. Intcp. Sq.
California ANG

Space Race

Regarding the so called "space race" between our country and the Soviet Union.

The Soviet Union has launched 15 successful satellites and space probes (counting Sputniks IV, VI, VII, VIII which were only partially successful). All of these launchings fall into five categories:

- **Launching of an earth satellite.**
- **Orbiting of live specimens.**
- **Orbiting of a heavy satellite.**
- **Launching of space probes.**
- **Recovery from orbit.**

The United States, on the other hand, has launched 61 successful satellites and space probes. All of these fall into at least eight categories:

- **Launching of an earth satellite.**
- **Study of radiation belts.**
- **Escape from earth.**
- **Reconnaissance.**
- **Recovery from orbit.**
- **Communications.**
- **Navigation.**
- **Weather.**

The main difference is that the Soviet Union has launched 10 satellites leading up to and including two manned shots. The others have to do with later manned moon and planet shots. The United States has not launched one satellite in connection with our man in space program.

Why doesn't the USSR launch satellites on missions like the ones our satellites are put up for? It's simple. On most of these we publish the information we get so that the Soviet Union doesn't have to repeat them.

I am not criticizing our program as such, but just showing the reasons why the USSR is ahead in the manned space race and why it will be difficult to overtake them.

I enjoy reading your magazine very much, but I have one request. On your "space vehicle logs" could you please also list the weight of the satellites launched—it is hard to find this information.

Bob Brooks
Sunnyvale, Calif.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Airline Business

I would like to make a comment or two on the letter "Airlines Scored" in the July 24 issue (p. 106).

I am thoroughly disgusted with the "air traveler of long standing" business man who thinks airplanes are like automobiles, and any man in the street can fly or do mechanical work on one. The aircraft of today are very complex, and airlines spend millions of dollars each year for training of their pilots, mechanics, and other personnel.

This man is undoubtedly confused, and knows very little about airlines of today.

If only he could see the inspections, check lists, paper work, time and trouble that goes into just one flight, I'm sure he would be utterly amazed.

One very important factor to point out to this "traveler of long standing," who was disgusted with the airlines because his flight was canceled just before takeoff, is that when you are on an aircraft flying at 20,000 ft. and at a speed of near Mach 1, if trouble is encountered, you cannot stop alongside a road and call the friendly serviceman to the rescue. (I think you get the point.)

As for the food on the airliners, I think its very good. I've been on a few flights myself, and have had no ill effects from the food yet. Of course, the airlines have a business to run. Every business has its own problems; the greatest of all it to get their passengers to their destination as quickly as possible, safe and happy. They go all out to do this but, of course, there are a few who do not appreciate it.

I would suggest to the "air traveler of long standing" to expand his line of thought, and consider just how much trouble the airlines go through in getting all their flights out and trying their best to please millions of travelers each day.

Remember, airlines lose money when flights are delayed or canceled; they only do it when there is a chance of endangering ones life if they don't.

Be considerate and keep flying; you'll find yourself enjoying your flights very much.

R. W. Bennett
Procter & Gamble

Systems Proposals

In reading your editorial, "Toward Genuine Competition," in the Oct. 9 issue, the following is my reaction regarding Vice Adm. John T. Hayward:

Perhaps he is projecting his own inadequacy in reacting in the manner of the typical demagogue—criticism in the form of broad and sweeping generalizations, implying everyone except him is an idiot in the technical publications field. I am quite certain the vast majority of proposals, no matter how sophisticated the proposed effort may be, are "constructed" with the customer in mind—both the technically qualified and those who are not!

My summary takes a syllogistic form: If Vice Adm. John T. Hayward understands or sees only the promotional aspects of proposals to the total exclusion of the technical content, and certainly this is implied by the ridiculous alternative of "some competitive prototype development"—considering the cost, may I suggest we get the decision making out of the hands of men who themselves gain stature by political showmanship" and who consider unfair competition imaginative proposals, based on documented, sound, technical competence.

In conclusion, a proposal is as much a piece of merchandising and advertising technique as a magazine ad or TV commercial. Of course, it is directed to a vastly more sophisticated audience and it must be truthful and well documented. The proposal is the prime means of convincing the customer that the company is the most qualified, prior to actual plant inspection by qualified inspectors.

The implied comparison between cost of proposal preparation and cost of prototype (which would require considerable technical publications work) is puerile.

Paul M. O'Keefe
Vision-Management Co.
Winchester, Mass.

Editorial Efforts

As an avid reader of Aviation Week, I wish to compliment you on two especially fine aspects of your magazine.

First, the reporting of all matters pertaining to military operations is unsurpassed. The accuracy and efficacy of the various articles are a credit to your reporters. As an individual with no contact with the aerospace industries and a limited technical background, I rely completely on your magazine to keep myself informed about the technical aspects of our national defense and any potential threats thereto.

Secondly, your editorials are consistently well written, concise, and convincing arguments on issues of national importance. If our government and national leaders would heed your opinions, I, for one, would have greater confidence in their decisions. It is a pleasure to see common sense and courage triumph over misunderstandings and self interest. My best regards and admiration for your outstanding editorial efforts.

Henry C. Miner, III
Old Greenwich, Conn.

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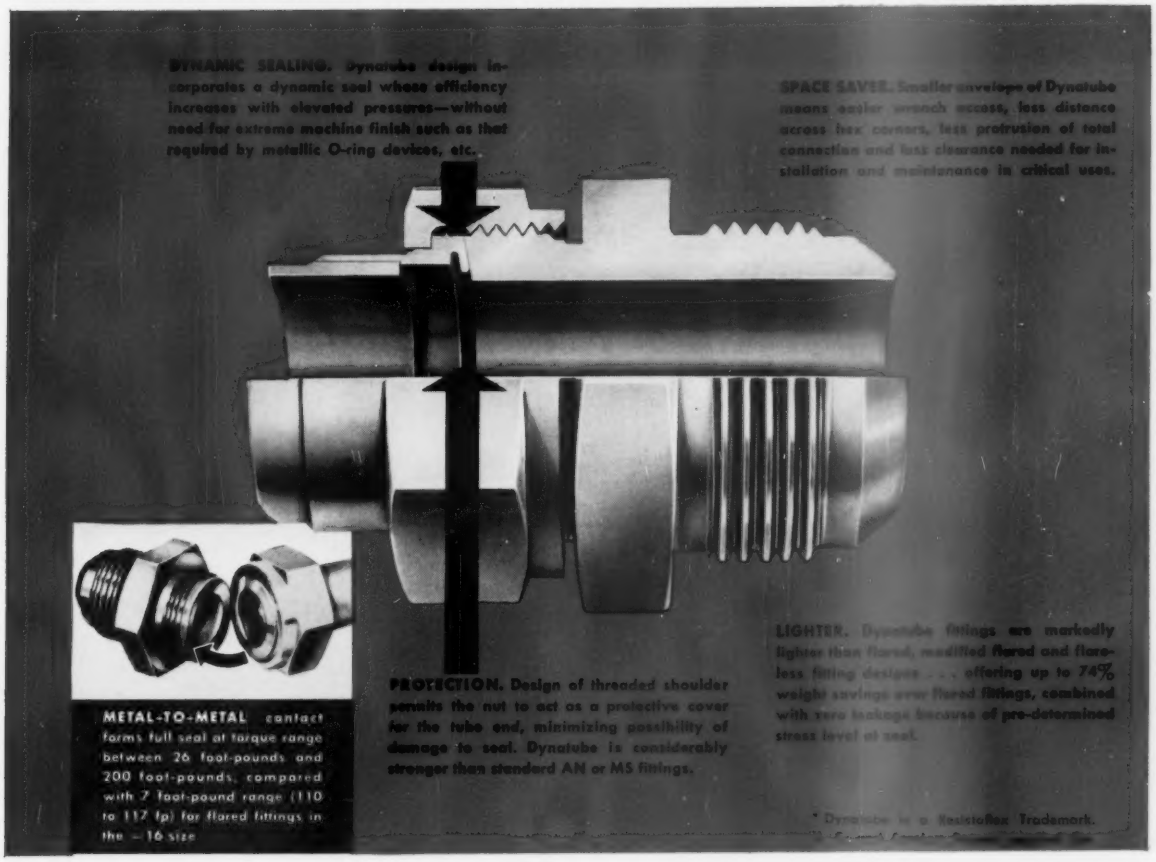
DYNAMIC SEALING. Dynatube design incorporates a dynamic seal whose efficiency increases with elevated pressures—without need for extreme machine finish such as that required by metallic O-ring devices, etc.
SPACE SAVER. Smaller envelope of Dynatube means easier wrench access, less distance across hex corners, less protrusion of total connection and less clearance needed for installation and maintenance in critical uses.
METAL-TO-METAL contact forms full seal at torque range between 26 foot-pounds and 200 foot-pounds, compared with 7 foot-pound range (110 to 117 fp) for flared fittings in the —16 size
PROTECTION. Design of threaded shoulder permits the nut to act as a protective cover for the tube end, minimizing possibility of damage to seal. Dynatube is considerably stronger than standard AN or MS fittings.
LIGHTER. Dynatube fittings are markedly lighter than flared, modified flared and flareless fitting designs . . . offering up to 74% weight savings over flared fittings, combined with zero leakage because of pre-determined stress level at seal.
* Dynatube is a Resistoflex Trademark.

Dynatube, another *first* by Resistoflex, is an all-new concept in metal rigid tube connections . . . providing a superior seal for high performance hydraulic, pneumatic, fuel and oxidizer systems.

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Dependence on surface finishes of sealing seats, concentricity of AN and MS screw machine parts and torque application is completely eliminated with Dynatube.

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OLD

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LH3489T, (180,000 psi)